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DIAGNOSES OF HAINAN PLANTS, II

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In the first paper of this series, published in 1922,[1] thirty-seven presumably new species were described. The present paper contains the descriptions of fifty-two additional forms which, like those in the first paper, are for the most part based on collections made by Mr. F. A. McClure, of the Canton Christian College. Mr. McClure's first trip to Hainan was made in September to December, 1921, and his second one in March to May, 1922. Most of the species described in the present paper were collected on the second trip.

Mr. McClure[2] has given a very interesting account of his work in Hainan, to which the reader is referred for details regarding the country and its vegetation. On both trips collections were made on Ng Chi Leng (Five Finger Mountain). This is the highest peak in Hainan, having an altitude of about 1,900 meters. The first attempt, in December, 1921, to reach the summit failed, but the goal was attained on April 30, 1922; Mr. McClure's party was the first to reach the top.

In connection with the work of identifying Mr. McClure's botanical collections, I have prepared a manuscript enumeration of Hainan plants. Previous to Mr. McClure's explorations in Hainan, but about three hundred seventy species had been definitely recorded from the island in botanical literature. His

[1] Philip. Journ. Sci. 21 (1922) 337–355.

[2] McClure, F. A., Notes on the island of Hainan, Lingnaam Agr. Rev. 1 (1922) 66–79, *t. 1–6*, map.

first collections, supplemented by material secured by other collectors, brought the number of species up to about one thousand twenty-five, while his second and more-extensive collections have increased the list to approximately one thousand three hundred seventy-five species, including the ferns and fern allies. Future explorations will unquestionably greatly increase this list.

It is impracticable here to enumerate all the species now known to occur in Hainan that are new to the Chinese flora. The value of the collections, aside from the numerous new species represented, may be estimated by the fact that one family, Ochnaceae, has been added to the Chinese list, as well as the following genera: *Arthropteris, Scleroglossum, Mapania, Arenga, Plagiostachys, Hedyosmum, Mitrephora, Polyosma, Ellipanthus, Luvunga, Heynea, Azadirachta, Xanthophyllum, Cleistanthus, Trewia, Ostodes, Gonocaryum, Arytera, Xerospermum, Mischocarpus, Ochna, Taraktogenos, Decaspermum, Rhynchosia, Epigynum, Kopsia, Fagraea, Rhynchotechum, Litosanthes,* and *Erechtites.* The genus *Tsoongia* of the Verbenaceae is described as new. One of the most remarkable finds is a representative of the genus *Hedyosmum,* of the Chloranthaceae, all other representatives of the genus being confined to tropical America.

LILIACEAE

PARIS HAINANENSIS sp. nov.

Herba erecta; foliis 6 vel 7, verticillatis, membranaceis, olivaceis, nitidis, glabris, obovatis ad oblongo-obovatis, usque ad 23 cm longis et 14 cm latis, apice breviter abrupte acuminatis, basi obtusis ad subacutis, 5-plinerviis, leviter inaequilateralibus vel aequilateralibus; petiolo 6 ad 7 cm longo; floribus longe pedunculatis; sepalis 6, lanceolatis, acuminatis, viridis, in siccitate subolivaceis, aequalibus, membranaceis, circiter 5 cm longis, 1.5 cm latis, utrinque subaequaliter angustatis, reticulatis; petalis 6, filiformibus, usque ad 10 cm longis, haud 1 mm latis; staminibus circiter 24, filamentis circiter 12 mm longis, antheris linearis, acuminatis, circiter 2 cm longis.

Ng Chi Leng and Ka La to Ta Hon, *McClure 9347* (type), *9213*, April 20 and 21, 1922, on moist rock faces in ravines and on forested slopes. Local name: *Tsat ip yat chi fa.*

A species belonging in the group with *Paris polyphylla* Sm., but, as variable as that species is, I do not see how the present form can correctly be referred to it. The sepals and petals are green, the stamens green and maroon, and the pistil is purple.

The underground stems are gathered for use for medicinal purposes.

MARANTACEAE

PHRYNIUM OLIGANTHUM sp. nov.

Herba circiter 1 m alta, glabra; foliis longe petiolatis, lamina chartacea, elliptica ad oblongo-elliptica, 30 ad 40 cm longa, 13 ad 17 cm lata, breviter acute acuminata, basi subrotundata; capitula oblonga, 5 ad 8 cm longa, 2.5 ad 3 cm diametro, immediate e vagina egrediens folio solitario comitata; bracteis glabris, exterioribus ellipticis, usque ad 4.5 cm longis et 3 cm latis, late rotundatis vel brevissime apiculato-acuminatis.

Ng Chi Leng, *McClure 9340, 9602* (type), April 20 and May 14, 1922, on forested slopes. Local name: *Chung ip* or *tung ip*.

The fugacious flowers are so badly preserved that no dissection is possible. They are described as yellow. The portion of the petiole above the insertion of the inflorescence attains a length of about 25 cm, the sheathing part being about 7 cm long and nearly 3 cm wide when spread. The species is manifestly allied to *Phrynium thorelii* Gagnep. of Indo-China, from which it is distinguished by its glabrous bracts.

FAGACEAE

QUERCUS HAINANENSIS sp. nov. § *Pasania*.

Arbor 5 ad 7 m alta, ramulis inflorescentiisque dense cinereo-pubescentibus, ramis teretibus, glabris; foliis chartaceis vel subcoriaceis, integris, oblongo-ellipticis, olivaceis, nitidis, 8 ad 14 cm longis, 3.5 ad 6 cm latis, perspicue acuminatis, basi acutis, supra glabris, costa nervisque impressis, subtus ad costa leviter pubescentibus glabrescentibus, nervis utrinque 15 ad 20, valde perspicuis, reticulis tenuibus, subparallelis; stipulis linearilanceolatis, circiter 4 mm longis; petiolo 1 cm longo, pubescente; spicis erectis, pedunculatis, 8 ad 11 cm longis, sub anthesin 6 mm diametro, floribus ♂ numerosis, confertis, ♀ paucis, dense pubescentibus; infructescentiis brevibus, spiciformibus, circiter 4 cm longis, fructibus junioribus plerumque binis vel trinis, circiter 1.5 cm diametro; cupulis hemisphaericis, crassis, cinereo-pubescentibus, squamis numerosis, lanceolatis, crassis, inflexis, 2 ad 3 mm longis; glandibus omnino immersis, apice truncato-convexis, junioribus cinereo-pubescentibus.

Ka La, Yik Tsok Mau, Ta Hon, and Sai Ching, *McClure 9764* (type), *9255, 9758, 9202,* April and May, 1922. On forested

slopes, in ravines, and along streams. Local names: *Shek tap shu, fu chui, fui kwoh,* and *chui shue.*

The type number presents immature fruits, the other numbers flowers only. The species is allied to *Quercus uvariifolia* Hance, from which it differs in numerous characters, notably in its nearly glabrous, fewer-nerved leaves, and like Hance's species belongs in the group with *Quercus cornea* Lour. It is probably more closely allied to the latter than to Hance's species, but can be at once distinguished by its entire leaves; however, in the larger leaves there are occasionally a few obscure teeth near the apices.

MENISPERMACEAE

CYCLEA HAINANENSIS sp. nov.

Frutex scandens, ramis ramulisque glabris; foliis ovatis vel triangulari-ovatis, chartaceis, olivaceis, circiter 11 cm longis et 8 cm latis, tenuiter acute acuminatis, basi late truncatis, vix cordatis, angulis late rotundatis, angustissime peltatis, 7-nerviis, nervis reticulisque subtus perspicuis et leviter ciliatis; petiolo 4 cm longo; paniculis ♀ caulinis, anguste pyramidatis, e basi ramosis, circiter 7 cm longis, ferrugineo-hirsutis, ramis inferioribus circiter 7 cm longis, patulis; floribus numerosis, subconfertis, bracteis anguste lanceolatis, hirsutis, 1 mm longis; sepalis 2, orbicularis, carnosis, glabris, 1 ad 1.2 mm diametro; petalis 0; ovarium glabrum.

Yik Tsok Mau, *McClure 9688,* May 18, 1922, on trees in forested ravines, the flowers white.

A species apparently most closely allied to *Cyclea polypetala* Dunn, but is distinguished by its smaller leaves with truncate, scarcely cordate bases, glabrous branches, and smaller panicles.

MAGNOLIACEAE

KADSURA HAINANENSIS sp. nov.

Frutex scandens, glaber, ramis ramulisque teretibus, purpureis; foliis coriaceis, oblongo-ovatis ad oblongis, 8 ad 12 cm longis, 3 ad 5 cm latis, sursum angustatis, acutis vel obtusis, basi rotundatis ad acutis, in siccitate olivaceis, nitidis, nervis utrinque circiter 8, tenuibus; petiolo 1 ad 1.5 cm longo; floribus axillaribus, solitariis, pedicellatis, pedicellis petiolo subaequantibus; sepalis exterioribus ovatis, rotundatis, 4 mm longis, interioribus ellipsoideis, 8 mm longis; petalis circiter 13, oblanceolatis, circiter 24 mm longis, 5 ad 8 mm latis, rotundatis vel obtusis, deorsum angustatis, interioribus angustioribus; stami-

nibus numerosis, filamentis 1.5 ad 2 mm longis, antheris 1 mm longis; stylis circiter 25, tenuibus, cylindraceis, 6 ad 8 mm longis.

Hainan, Yan Fa, *McClure 9542* (type), *9524a* (*? 9542a*), in thickets, May, 1922.

The specimens were originally identified as *Kadsura lanceolata* King, but an analysis of the flowers showed at once that the material represented a form remote from King's species. It is distinguished not alone by its vegetative characters and its ellipsoid buds, but also by its more-numerous, longer, differently shaped petals, and from all species in the genus by its slender elongated styles.

KADSURA OBLONGIFOLIA sp. nov.

Frutex scandens, glaber, ramis ramulisque teretibus, rubro-brunneis, ramulis elongatis, vix 1.5 mm diametro; foliis oblongis ad anguste oblongis, 4 ad 9 cm longis, 1 ad 2.5 cm latis, membranaceis vel chartaceis, integris, vel margine dentibus glandulosis paucis obscuris instructis, basi acutis, apice obtusis vel obscurissime obtuse acuminatis, nervis utrinque 6 ad 8, tenuibus, obscuris; petiolo 6 ad 10 mm longo; floribus ignotis, axillaribus, solitariis, longe pedunculatis, pedunculo sub fructu usque ad 3 cm longo; fructibus ovoideis vel ellipsoideis, usque ad 2 cm longis, circiter 1.3 cm diametro, carpellis numerosis, globosis ad subellipsoideis, circiter 4 mm longis.

Nodoa and Pat Ka Leng, *McClure 8011* (type), *7866, 7973*, November, 1922, in thickets, altitude about 250 meters.

This may be the Hainan form recorded by Gagnepain as *Kadsura lanceolata* King; but, if so, I do not see how it can be referred to King's species, from which it differs notably in its differently shaped, relatively much narrower, thinner, usually obtuse leaves; the peduncles being much longer than the petioles; and the differently shaped, smaller fruits. It is apparently nearer *K. japonica* Juss. than *K. lanceolata* King. It seems probable, from a comparison of descriptions, that the Indo-China *Kadsura lanceolata* as interpreted by Gagnepain is specifically distinct from the original Malay Peninsula form.

ANONACEAE

FISSISTIGMA (MELODORUM) MACLUREI sp. nov.

Scandens (?), ramis glabris, ramulis tenuibus, pubescentibus; foliis chartaceis, olivaceis, oblongis ad oblongo-lanceolatis, 7 ad 10 cm longis, 2.3 ad 3 cm latis, tenuiter subcaudato-acuminatis, basi rotundatis, in siccitate olivaceis, supra glabris, subtus pallid-

ioribus, ad costa nervisque leviter pubescentibus; nervis utrinque circiter 8, tenuibus, subtus elevatis, perspicuis, curvato-adscendentibus; petiolo 3 ad 4 mm longo; floribus solitariis, axillaribus, dense ferrugineo-villosis; pedicellis usque ad 7 mm longis, deorsum bracteolis ovatis 5 mm longis instructis; sepalis late ovatis, obtusis, 4 mm longis; petalis exterioribus ellipticoovatis, crasse coriaceis, 9 mm longis, 4.5 mm latis, interioribus crassioribus, ovatis, paullo brevioribus, intus glabris; antheris 1.5 ad 2 mm longis; carpellis usque ad 10, oblongo-cylindraceis, pilosis, ut videtur 4-ovulatis, 2 mm longis; stylis crassis, stigmate integro; fructibus obovoideis ad oblongis, 2 ad 3.5 cm longis, 1.5 cm diametro, ferrugineo-puberulis.

Yik Tsok Mau, *McClure 9733*, May 19, 1922, in forested ravines. Local name: *Shan tsiu*.

This species is aparently well characterized by its rather thin, subcaudate-acuminate leaves, but its true alliances are not clear to me. It is manifestly a *Fissistigma*, although Mr. McClure's notes indicate that it is a tree 15 m high with the trunk 30 cm in diameter. There is probably some error here.

FISSISTIGMA OBTUSIFOLIUM sp. nov.

Frutex scandens, foliis subtus minute puberulis inflorescentiisque ferrugineo-pubescentibus exceptis glaber; ramis ramulisque teretibus, tenuibus, atro-purpureis; foliis chartaceis vel subcoriaceis, oblongis ad oblongo-ellipticis, 7 ad 11 cm longis, 2.5 ad 4.5 cm latis, utrinque late rotundatis, apice plerumque retusis, in siccitate pallidis, supra glabris, subtus subglaucescentibus, nervis utrinque 12 ad 14, tenuibus, subtus perspicuis; petiolo glabro, circiter 7 mm longo; inflorescentiis axillaribus, fasciculatis vel depauperato-cymosis, ferrugineo-pubescentibus; floribus longe pedicellatis, pedicellis usque ad 16 mm longis, deorsum bracteolis parvis instructis; sepalis triangulari-ovatis, acutis, pubescentibus, 1.7 mm longis; petalis exterioribus late ovatis, saltem 5 mm longis, circiter 4 mm latis, extus ferrugineo-pubescentibus, interioribus oblongis ad oblongo-ovatis, circiter 4 mm longis, 2.5 ad 3 mm latis, extus puberulis, intus glabris; carpellis circiter 15, pubescentibus, 1 mm longis, sursum angustatis; stylis angustate oblongis, subteretibus vel leviter compressis, 0.8 mm longis, stigmate glabro.

Fan Ya, *McClure 9606*, May 14, 1922, in thickets along roads.

A species well characterized by its small, fascicled or depauperate-cymose, long-pedicelled flowers and by its elliptic to

oblong-elliptic leaves which are broadly rounded at both base and apex, the apex usually retuse.

POLYALTHIA CONSANGUINEA sp. nov. § *Eupolyalthia.*

Arbor parva, 3 ad 4 m alta, ramulis dense ferrugineo-pilosis; foliis chartaceis, brevissime petiolatis, oblongis ad oblongo-lanceolatis vel oblanceolatis, 10 ad 16 cm longis, 2.5 ad 4 cm latis, glabris vel subtus ad costa leviter pilosis, in siccitate pallidis, apice acuminatis, basi angustatis, minute cordatis vel auriculato-cordatis, plerumque leviter obliquis, nervis utrinque circiter 12, subtus elevatis, perspicuis, arcuato-anastomosantibus; petiolo circiter 2 mm longo, ferrugineo-pubescente; floribus pedicellatis, solitariis, extra-axillaribus; pedicellis 1 ad 1.8 cm longis, ferrugineo-pubescentibus, deorsum bracteolis 2 vel 3 parvis instructis; sepalis triangulari-ovatis, obtusis, coriaceis, leviter pilosis, 3 mm longis; petalis coriaceis, oblongis, subaequalibus, 10 mm longis, 3.5 mm latis, obtusis vel acutis, extus leviter pubescentibus, intus glabris; antheris numerosis; carpellis oblongis, 1 mm longis, leviter pubescentibus, 2-ovulatis; stigmate capitato-obovato, leviter pubescente; fructibus subglobosis, verruculosis, glabris, 1 cm diametro, longe pedicellatis.

Sha Po Leng and Ng Chi Leng, *McClure 8192, 9323, 9508* (type), November 11, 1921, April 28 and May 9, 1922, the first in fruit, the last two in flower. In forested ravines at and above 450 meters altitude.

A species in the group with *Polyalthia obliqua* Hook. f. & Th. and apparently most closely allied to *P. corticosa* Finet & Gagnep., but the petals are entirely free, glabrous within and not pubescent on both surfaces, while the pedicels of the mature fruits are verrucose and up to 12 mm in length.

POLYALTHIA CRASSIPETALA sp. nov. § *Monoon.*

Arbor circiter 5 m alta, plus minusve ferrugineo-pilosa; ramis teretibus, glabris, lenticellatis, ramulis dense ferrugineo-pilosis; foliis brevissime petiolatis, oblongis ad oblongo-lanceolatis, chartaceis, 5 ad 7 cm longis, 1.5 ad 2.5 cm latis, in siccitate brunneo-olivaceis, opacis, supra ad costa pilosis, subtus plus minusve pilosis, apice obtuse acuminatis, basi subacutis, nervis utrinque circiter 8, tenuibus, adscendentibus; floribus axillaribus, solitariis, longe pedicellatis; pedicellis ferrugineo-pilosis, usque ad 2 cm longis, deorsum bracteis foliaceis oblongis circiter 1 cm longis instructis; sepalis oblongo-ovatis ad late lanceolatis, subcoriaceis,

acuminatis, 10 mm longis, 4 ad 5 mm latis, pilosis; petalis subaequalis, crasse coriaceis, oblongo-ovatis, obtusis, 8 ad 9 mm longis, 4.5 ad 5 mm latis, leviter pilosis, in siccitate atris; antheris numerosis, connectivo truncato; ovario piloso, 1-ovulato, stylis 0.7 mm longis, stigmate villoso.

Notia, *McClure 8976*, April 11, 1922, in thickets between dry fields. The flowers are yellow and greenish, very fragrant, and the fruits are said to be edible. Local name: *Lo yan pi.*

A species rather strongly characterized by the large bracts, borne on the lower half of the pedicels, and by its very thick petals being slightly shorter than the distinctly thinner sepals.

LAURACEAE

LITSEA LANCILIMBA sp. nov.

Arbor circiter 8 m alta, glabra (floribus ignotis), ramulis circiter 6 mm diametro, teretibus, rubro-brunneis; foliis alternis, lanceolatis, 14 ad 18 cm longis, 3.5 ad 4.5 cm latis, coriaceis, tenuiter acute acuminatis, basi cuneatis, supra pallide olivaceis, nitidis, subtus glaucescentibus, vix foveolatis, nervis utrinque circiter 12, curvato-adscendentibus, utrinque cum reticulis distinctis; petiolo 3 cm longo; umbellulis axillaribus, ut videtur paucifloris, solitariis, pedunculis sub fructu valde incrassatis, usque ad 5 mm longis; fructibus oblongo-ellipsoideis, 2.5 cm longis, 1.4 cm diametro, in siccitate atris, rugosis, calycis accrescentibus subpatelliformibus, circiter 1 cm diametro, obscure irregulariter lobatis, brunneis, nitidis, rugosis, pedicellis cylindraceis, circiter 8 mm longis et 5 mm crassis.

Ng Chi Leng, *McClure 9353*, April 29, 1922, on forested slopes, altitude about 900 meters. Local name: *Pat kok.*

A species recognizable by its lanceolate acuminate leaves which are somewhat glaucous beneath and entirely glabrous on both surfaces, as well as by its paired oblong-ellipsoid black fruits and its thick-pedicelled, somewhat saucer-shaped accrescent calyces.

LITSEA MACLUREI sp. nov.

Arbor 5 ad 8 m alta, ramulis junioribus et subtus foliis minute puberulis, glabrescentibus; foliis alternis, oblongis, coriaceis, 11 ad 18 cm longis, 3 ad 5 cm latis, breviter obtuse acuminatis vel obtusis, basi cuneatis, supra in siccitate olivaceis vel viridis, subtus glaucescentibus, obscure et nec profunde sub-foveolatis; nervis utrinque 7 vel 8, curvatis, subtus conspicuis, vix anasto-

mosantibus, reticulis subobsoletis; petiolo 1 cm longo; umbellulis axillaribus, paucis, fasciculatis, pedunculatis, pubescentibus, pedunculo 7 mm longo, bracteis involucrantibus ovatis, concavis, 4 mm longis; floribus ♂ paucis, pubescentibus, tubo 3 mm longo, lobis 2 mm longis, staminibus 9; fructibus ellipsoideis, glabris, nitidis, 2.5 cm longis, 2 cm diametro, calycis accrescentibus obconicis, 2 cm longis, crasse coriaceis, glabris, verrucosis, truncatis.

Ng Chi Leng, *McClure 9360, 9586* (type), *8658*, April and May, 1922, December, 1921, in forested ravines near the cave on the south slope of the mountain, altitude about 900 meters.

A species in the same general group as the Philippine *Litsea albayana* Vid. and strongly resembling that species, differing however notably in its much larger and differently shaped fruits and larger, accrescent calyces. It differs from *Litsea vang* H. Lecomte of Indo-China by its leaves being more or less glaucous beneath; by its much shorter petioles; by its solitary or fascicled sessile fruits; and by its accrescent calyces being grayish and verruculose, not black and smooth when dry.

SAXIFRAGACEAE

DICHROA MOLLISSIMA sp. nov.

Frutex 1.5 m altus, ramulis et subtus foliis molliter villosis, ramis ramulisque teretibus, tenuibus, ramis glabris; foliis oblongo-ellipticis, chartaceis ad submembranaceis, 10 ad 15 cm longis, 2.5 ad 3.5 cm latis, supra olivaceis, nitidis, glaberrimis, subtus pallidioribus, molliter villosis, utrinque subaequaliter angustatis, apice acute acuminatis, basi acutis, margine sursum distanter denticulatis; nervis utrinque 6 vel 7, subtus distinctis, curvatis; petiolo 1 ad 3 cm longo; inflorescentiis terminalibus, pedunculatis, circiter 7 cm longis, pubescentibus; calycis cupulatis, 1.5 mm longis, lobis subpatulis, ovatis, acutis, 1 mm longis; petalis oblongo-ovatis ad lanceolato-ovatis, acutis ad acuminatis, apice inflexis, 3.5 mm longis, glabris; filamentis 1.2 ad 2 mm longis, antheris ellipsoideis, 1 mm longis; stylis 4, crassis, 1.6 mm longis.

Ng Chi Leng, *McClure 9373*, April 29, 1922, in forested ravines above the cave on the south slope of the mountain.

A species characterized by the softly villous lower surfaces of its leaves, which is the most striking differential character between it and the allied *Dichroa febrifuga* Lour.

CONNARACEAE

ELLIPANTHUS GLABRIFOLIUS sp. nov.

Arbor circiter 8 m alta, inflorescentiis fructibusque exceptis glabra, ramis ramulisque teretibus; foliis oblongis ad oblongo-lanceolatis, coriaceis, 10 ad 14 cm longis, 3 ad 3.5 cm latis, in siccitate pallide brunneis, apice obtuse acuminatis, basi obtusis ad subrotundatis, utrinque minute subfoveolatis, nervis utrinque circiter 9, tenuibus, subtus distinctis, arcuato-anastomosantibus; petiolo 1.5 ad 1.8 cm longo; inflorescentiis in axillis superioribus vel terminalibus, brevibus, cymosis, ferrugineo-pubescentibus; folliculis densissime ferrugineo-tomentosis, circiter 2.5 cm longis et 1 cm diametro, stipitatis, apiculatis, leviter compressis, obscure falcatis, intus glabris.

Ka La, *McClure 9180*, April 20, 1922, on dry slopes apparently at low altitudes.

The genus is new to China. Apparently allied to *E. cinereus* Pierre and *E. subrufus* Pierre of Indo-China, but with differently shaped, entirely glabrous leaves.

RUTACEAE

ACRONYCHIA OLIGOPHLEBIA sp. nov.

Arbor parva, circiter 7 m alta, inflorescentiis parcissime pubescentibus exceptis glabra, ramis ramulisque teretibus, rubro-brunneis; foliis oblongo-obovatis ad oblongo-ellipticis, chartaceis, subolivaceis, nitidis, 7 ad 14 cm longis, 3.5 ad 6 cm latis, apice plerumque late rotundatis, basi acutis, nervis utrinque circiter 6, patulis, distantibus, subtus perspicuis, arcuato-anastomosantibus, reticulis laxis; petiolo 1 ad 1.7 cm longo; inflorescentiis axillaribus, circiter 8 cm longis, paucifloris; floribus 4-meris, in ramulis ultimis subumbellatim dispositis, pedicellis circiter 5 mm longis, parce adpresse pubescentibus; sepalis triangularibus, acutis, 1 mm longis, obscure pubescentibus; petalis oblongo-ovatis, acutis, 3.5 mm longis, intus obscurissime pubescentibus; filamentis 3 mm longis, glaberrimis, antheris 1.2 mm longis; ovario glabro; stigmate sessile, 4-angulato, 0.3 mm diametro.

Ng Chi Leng, *McClure 9496*, May 9, 1922, in forested ravines on the south slope of the mountain, the flowers yellow and green, fragrant.

A strongly marked species most closely allied to the Philippine *Acronychia obovata* Merr., from which it is at once distinguishable by its thinner, distantly and much fewer-nerved leaves, and shorter petioles.

CLAUSENA MONINGERAE sp. nov.

Frutex 1.5 m altus vel arbor parva, usque ad 7 m alta, partibus junioribus distincte cinereo-pubescentibus, ramis teretibus, glabrescentibus; foliis 10 ad 15 cm longis, petiolis rhachibusque pubescentibus; foliolis circiter 21, oblongis, valde obliquis, 1.5 ad 3 cm longis, 8 ad 11 mm latis, punctatis, utrinque plus minusve pubescentibus, integris, rotundatis ad obtuse acuminatis, basi perspicue inaequilateralibus, uno latere rotundatis altero multo angustioribus acutis, nervis utrinque circiter 6; paniculis terminalibus, pyramidatis, 12 ad 15 cm longis, ramis inferioribus usque ad 7 cm longis, pubescentibus; floribus 4-meris, calycis acute 4-angulatis, 1.2 mm diametro; petalis ellipticis, rotundatis, 4 mm longis, glabris; filamentis 2 mm longis, sursum angustatis, antheris ellipsoideis, 1.2 mm longis; ovario cylindrico, leviter villoso; stylis crassis, cylindraceis, 1.2 mm longis.

Tai Wan San Hui, Kingchow, and without locality, *McClure 8803, 8995* (type), *Moninger s. n.*, April, 1922, and June, 1920, in thickets along roads. Local names: *Ka wong pi, tang lung shu,* and *kai tan wong.*

The specimens were originally referred to *Clausena excavata* Burm. f., but represent a form rather remote from that species and one distinctly allied to the Formosan *C. lunulata* Hayata. It is characterized especially by its numerous, small, very oblique leaflets, and its relatively elongated filaments which are nearly twice as long as the anthers. It differs from Hayata's species in its 4-merous flowers, evidently more conspicuous indumentum, and in its fewer leaflets.

MELIACEAE

DYSOXYLUM LUKII sp. nov. § *Eudysoxylum.*

Arbor 4 ad 5 m alta, perspicue molliter pubescens; ramulis ultimis circiter 1 cm diametro, dense subferrugineo-pubescentibus; foliis alternis, distantibus, circiter 60 cm longis, petiolis rhachibusque dense pubescentibus; foliolis 9 ad 11, plerumque alternis, lanceolatis vel oblongo-lanceolatis, chartaceis, 10 ad 17 cm longis, 3 ad 4 cm latis, olivaceis, nitidis, acuminatis, basi perspicue inaequilateralibus, uno latere rotundatis altero acutis, supra, costa dense pubescens excepta, subglabris, subtus molliter villosis; nervis utrinque circiter 30, perspicuis, patulis, curvatis, ad margine arcuato-anastomosantibus; paniculis supra-axillaribus, quam foliis multo brevioribus, circiter 20 cm longis, ramosis, pubescentibus; floribus 4-meris, longe pedicellatis (pedicellis 4 mm longis, pubescentibus); calycis subpatelliformibus, pubes-

centibus, 2.5 mm diametro, obscure lobatis; petalis liberis, oblongis, 6.5 mm longis, 2.6 mm latis, extus pubescentibus; tubo cylindrico, 5 mm longo, 2 mm diametro, glabro, libero, leviter crenulato; antheris 8, oblongis, 1 mm longis, inclusis; discus cupulatus, crenulatus, 1 mm altus; ovario villoso; stylis 4 mm longis, deorsum villosis, sursum glabris, stigmate subcapitato.

Ka La, *McClure 9196*, April 21, 1922, on rocky stream banks.

A strongly marked species, according to C. de Candolle's arrangement falling in the group with *Dysoxylum arborescens* Miq., but not at all closely allied to it or to its associated species. It is dedicated to Luk Tak, one of the Chinese collectors who accompanied Mr. McClure on his second trip to Hainan.

EUPHORBIACEAE

ANTIDESMA MACLUREI sp. nov.

Arbor circiter 5 m alta, partibus junioribus inflorescentiisque exceptis glabra, ramis tenuibus, teretibus, glabris, cinereis, ramulis leviter puberulis vel pubescentibus; foliis lanceolatis, membranaceis, 7 ad 11 cm longis, 2 ad 3 cm latis, in siccitate pallidis, nitidis, tenuiter acute acuminatis, basi rotundatis ad subacutis, nervis utrinque circiter 7, tenuibus, distinctis, utrinque glabris vel subtus ad costa leviter pubescentibus; petiolo circiter 8 mm longo, pubescente; stipulis caducis, ignotis; inflorescentiis ♀ in axillis superioribus, solitariis, paniculatis, laxis dense subferrugineo-pubescentibus vel puberulis, usque ad 8 cm longis, ramis paucis, distantibus, patulis, inferioribus circiter 3 cm longis; floribus ♀ in ramis primariis racemose dispositis, breviter (1 mm) pedicellatis, 4-meris, calycis lobis anguste ovatis, acutis, vix 1 mm longis; bracteolis lanceolato-ovatis, acuminatis, pedicellis subaequantibus; fructibus junioribus oblongis, leviter inaequilateralibus, in siccitate pruinosis, vix rugosis, circiter 3 mm longis, acuminatis, stigmate terminale.

Ng Chi Leng, *McClure 9551*, May 13, 1922, in forests.

A species in many respects resembling *Antidesma japonicum* S. & Z. and *A. gracile* Hemsl., differing notably in its paniculate inflorescences.

CLEISTANTHUS SAICHIKII sp. nov. § *Leiopyxis*.

Frutex 3 ad 4 m altus, ramulis junioribus floribusque exceptis glaber; ramis ramulisque teretibus, tenuibus, ramulis junioribus glabris vel parce ciliatis; foliis chartaceis, laevis, utrinque nitidis, ellipticis ad ovato-ellipticis vel oblongo-ellipticis, in siccitate pallidis, 3 ad 7 cm longis, 1 ad 3.5 cm latis, perspicue sed obtuse

acuminatis, basi rotundatis ad late acutis, nervis utrinque 5 vel 6, tenuibus, obscuris, reticulis subobsoletis; floribus ♂ axillaribus, paucis, solitariis vel fasciculatis, sessilibus, circiter 6 mm diametro, sepalis glabris, ovato-lanceolatis, acuminatis, 3 mm longis; petalis orbicularis, rotundatis, glabris, 0.5 mm diametro; ovarium villosum; discus cupuliformis ovarium arcte includens.

Fan Ta, *McClure 9148,* April 18, 1922, in thickets.

This species in general closely resembles *Cleistanthus sumatranus* Muell.-Arg., *C. gracilis* Hook. f., and *C. laevis* Hook. f. and, as with these species, the flowers are for the most part borne on the ultimate branchlets in the axils of the smaller leaves. Among other characters it differs from these species in its orbicular petals. It is the first representative of the genus to be found in China, as I have elsewhere shown that *Cleistanthus monoicus* Muell.-Arg. is identical with *Bridelia tomentosa* Blume = *B. monoica* (Lour.) Merr. Sai Chik, to whom the species is dedicated, was a general assistant to Mr. McClure on his second trip to Hainan.

BUXACEAE

SARCOCOCCA EUPHLEBIA sp. nov.

Frutex usque ad 1.5 m altus, glaber, ramis teretibus, ramulis sulcato-angulatis; foliis oblongo-lanceolatis, membranaceis, nitidis, 10 ad 16 cm longis, 3 ad 6 cm latis, acuminatis, basi acutis, perspicue 3-plinerviis, integris, costa nervisque supra impressis, subtus valde perspicuis, nervis utrinque 4 vel 5, distantibus, arcuato-anastomosantibus, reticulis laxis; inflorescentiis axillaribus, quam petiolis brevioribus, paucifloris, sepalis bracteolisque lanceolatis, acuminatis, 2 ad 2.5 mm longis, leviter ciliatis; fructibus ovoideis ad subglobosis, circiter 1 cm longis, rubris, in siccitate rubro-castaneis.

Ng Chi Leng, *McClure 9589* (type), *8586,* May 14, 1922, and December 21, 1921, in forested ravines and on cliffs, altitude about 750 meters.

A species strongly characterized by its very prominently nerved leaves, the midrib and the distant nerves being more or less impressed on the upper surface and very prominent on the lower surface. The basal nerves extend toward the apex at a distance of from 6 to 10 mm from the margins of the leaves and are more or less arcuate between the ends of the lateral nerves. As variable as is *Sarcococca saligna* Muell.-Arg., I do not see how the present form can possibly be referred to it.

SAPINDACEAE

XEROSPERMUM TOPENGII sp. nov.

Arbor circiter 10 m alta, subglabra, ramis teretibus, glabris, ramulis puberulis; foliis 20 ad 25 cm longis, foliolis 5, oblongo-lanceolatis, chartaceis, 10 ad 15 cm longis, 3 ad 4 cm latis, acuminatis, basi acutis, plerumque inaequilateralibus, supra olivaceis, glabris, nitidis, subtus pallidis, subglaucescentibus, leviter pubescentibus, nervis utrinque circiter 14, subtus perspicuis, reticulis utrinque distinctis; paniculis sub fructu 10 ad 12 cm longis, plus minusve pubescentibus; floribus ignotis; fructibus ellipsoideis, 2 ad 2.5 cm longis, rotundatis, in siccitate atro-castaneis, muricatis, processibus rigidis, 2.5 ad 3.5 mm longis, rectis vel leviter curvatis, obtusis vel truncatis, sulcatis, 0.5 ad 1 mm latis, basi pyramidatis.

Ng Chi Leng, *McClure 9455*, May 5, 1922, on forested slopes on the southern side of the mountain.

This species was originally referred to *Nephelium*, but by the characters given by Radlkofer it appears better placed in *Xerospermum*. It is definitely more closely allied to *X. muricatum* Radlk., of Burma and the Malay Peninsula, than to any of the species of Indo-China, authentically named specimens of all the Indo-Chinese species being available to me for purposes of direct comparison. It differs notably from *X. muricatum* Radlk. in its long-muricate fruits, the stiff, straight or curved processes attaining a length of 3.5 mm. The genus is new to China. Local name: *Shan li chi*.

SABIACEAE

MELIOSMA BUCHANANIFOLIA sp. nov.

Arbor circiter 12 m alta, inflorescentiis subferrugineo-pubescentibus exceptis glabra; ramis teretibus, circiter 5 mm diametro, perspicue lenticillatis; foliis oblongo-oblanceolatis ad oblanceolatis, subcoriaceis, olivaceis, utrinque concoloribus nitidisque, 14 ad 20 cm longis, 4 ad 6 cm latis, acuminatis, basi cuneatis, margine integris; nervis utrinque circiter 18, perspicuis, arcuato-anastomosantibus, reticulis distinctis; petiolo circiter 2 cm longo; paniculis terminalibus et in axillis superioribus, erectis, dense multifloris, pedunculatis, usque ad 18 cm longis; floribus in ramulis ultimis racemose dispositis, confertis, breviter pedicellatis, 3 mm diametro; sepalis ovatis, obtusis, 1 mm longis, leviter pubescentibus; petalis majoribus late ovatis, 2 ad 2.5 mm longis, minoribus lanceolatis, 2 mm longis, 0.8 mm latis; filamentis

fertilibus 1 mm longis, cupulis 1 mm diametro, sterilibus 1.2 mm longis, incrassatis, truncatis, incurvatis, cristatis; ovario pubescente; stylis 1 mm longis.

Yik Tsok Mau, *McClure 9732,* May 19, 1922, in forested ravines, the flowers yellowish white. The local name is recorded as *Fa muk heung,* with the statement that the Chinese on the mainland use the bark of the tree for making incense.

The species belongs in the group with *Meliosma simplicifolia* Roxb. and strongly resembles the common forms of *Buchanania arborescens* Blume; so much so that on preliminary examination the specimen was so named. Among other characters it is distinguishable from Roxburgh's species in its larger, distinctly pedicelled flowers, pubescent ovaries, and thicker leaves.

MELIOSMA TSANGTAKII sp. nov.

Arbor circiter 20 m alta, ramulis et subtus foliis ad costa nervisque dense ciliatis, paniculis dense pubescentibus; ramis teretibus, glabris, circiter 4 mm diametro, ramulis brunneis, leviter lenticellatis; foliis simplicibus, integerrimis, oblongis ad oblongo-ellipticis vel oblongo-obovatis, coriaceis, 7 ad 12 cm longis, 3 ad 3.5 cm latis, subcaudato-acuminatis, basi cuneatis, supra glabris, nitidis, olivaceis, costa nervisque impressis, subtus pallide brunneis, perspicue ciliatis, nervis utrinque circiter 10, adscendentibus, valde perspicuis; petiolo 1.5 ad 4 cm longo, pubescente; paniculis terminalibus, erectis, 10 ad 12 cm longis, pedunculatis, dense pubescentibus, ramis inferioribus usque ad 4 cm longis, patulis vel adscendentibus; floribus numerosissimis, sessilibus, sepalis leviter pubescentibus, ovatis, 1 mm longis; petalis majoribus orbiculari-ovatis, 2 mm diametro, minoribus oblanceolatis ad spatulatis, 1.5 mm longis; filamentis fertilibus 0.8 mm longis, cupulis 0.5 mm diametro, sterilibus 1.5 mm longis, truncatis, incrassatis, cristatis, ovario glabro, stylis 1 mm longis.

Ng Chi Leng, *McClure 9438* (type), *9498,* May 4 and 9, 1922, in densely forested ravines on the south slope of the mountain.

A species strongly characterized by its prominently nerved, subcaudate-acuminate, long-petioled, coriaceous leaves which are olivaceous, shining, and with prominently impressed lateral nerves and costa on the upper surface, the lower surface being pale brownish and rather densely ciliate, especially on the conspicuous ascending nerves and on the costa. It is dedicated to Tsang Tak, one of the attachés of Mr. McClure's second expedition to Hainan.

TILIACEAE

GREWIA CHUNGII sp. nov.

Arbor 6 ad 15 m alta, partibus junioribus dense ferrugineo-pubescentibus, subtus foliis parce stellato-furfuraceis; foliis oblongis, subcoriaceis, 12 ad 17 cm longis, 3.5 ad 5.5 cm latis, basi rotundatis, 3-nerviis, apice acuminatis, margine integris vel sursum minute distanter denticulatis, supra glabris, pallide olivaceis vel brunneis; nervis utrinque circiter 5, adscendentibus, subtus perspicuis, anastomosantibus; petiolo circiter 1 cm longo; inflorescentiis paniculatis, 4 ad 6 cm longis; sepalis 9 mm longis, obtusis, dense stellato-pubescentibus, margine inflexis; petalis anguste oblongis, 4 mm longis, obtusis, glandulis basilaribus incrassatis, pubescentibus; ovario pubescente; stylis glabris, 3 mm longis, tenuibus, obscurissime 2- vel 3-lobatis, lobis angustis, glabris.

Ng Chi Leng and Ka La, *McClure 9314, 9197* (type), April, 1922, in forested ravines along streams.

A species belonging in the group with *Grewia paniculata* Roxb., but differing from Roxburgh's species in its oblong entire or nearly entire leaves which are only slightly stellate-furfuraceous and not softly tomentose on the lower surface; its shorter panicles; and its longer sepals. The flowers are arranged in groups on the ultimate branchlets of the inflorescence and subtended by an involucre of densely pubescent bracts which vary from oblanceolate to obovate, when obovate being frequently deeply 2-lobed, the lobes somewhat divaricate. The species is dedicated to Chung Yuk Fan, one of the attachés of Mr. McClure's second expedition to Hainan.

THEACEAE

ADINANDRA HAINANENSIS sp. nov.

Frutex vel arbor parva, floribus ramulisque exceptis glabra; ramis teretibus, glabris, purpureis, ramulis junioribus adpresse pubescentibus; foliis obovatis ad obovato-ellipticis, coriaceis, nitidis, pallide olivaceis, glabris, 5 ad 7 cm longis, 2.5 ad 3.5 cm latis, abrupte acuminatis, basi cuneatis, margine minute corniculato-crenatis, corniculis incurvatis, subtus glandulosis, glandulis purpureis vel brunneis, nervis primariis utrinque circiter 10, quam secondariis paullo distinctioribus, reticulis, praesertim supra, perspicuis; petiolo circiter 5 mm longo; floribus axillaribus, solitariis, sepalis ovatis, coriaceis, acutis vel acuminatis, 7 mm longis, extus dense adpresse pubescentibus, pedicellis aequantibus.

Ng Chi Leng, *McClure 9571*, May 13, 1922, in forested ravines.

A species clearly distinct from the few forms known from China and contiguous regions, well characterized by its short petioles and its leaves being rather conspicuously glandular beneath.

EURYA CILIATA sp. nov.

Arbor circiter 10 m alta, ramulis et subtus foliis, praesertim ad costa, et fructibus dense longe ciliatis; foliis subsessilibus, lanceolatis, chartaceis, 5 ad 7 cm longis, 1 ad 2 cm latis, acuminatis, basi rotundatis, distincte inaequilateralibus, minute cordatulis, margine integris vel minute denticulatis, supra subviridis, nitidis, glabris, costa profunde impressis, subtus pallidioribus, ciliatis, costa dense ciliatis, nervis utrinque circiter 14, patulis, anastomosantibus; fructibus axillaribus, numerosis, solitariis vel fasciculatis, breviter pedunculatis, ovoideis, 4 ad 5 mm longis, dense pallide ciliatis, sepalis persistentibus ellipsoideis, rotundatis, 2 mm longis, extus pubescentibus; stylis plerumque 4, liberis, glabris, 2 mm longis.

Ng Chi Leng, *McClure 9319*, April 28, 1922, in forested ravines near the cave, south slope of the mountain.

A strongly marked species, readily recognizable by its indumentum, and especially by its ovoid fruits being densely ciliate with long pale hairs.

GUTTIFERAE

GARCINIA HAINANENSIS sp. nov. § *Discostigma*.

Arbor 10 m alta, ramis teretibus, olivaceis, in siccitate rugosis, ramulis ultimis 2 mm diametro; foliis oblongo-obovatis ad oblanceolatis, chartaceis vel subcoriaceis, in siccitate pallidis, 6 ad 10 cm longis, 2 ad 3.5 cm latis, breviter acuminatis vel acutis, basi acutis, margine distincte revolutis; nervis utrinque circiter 15, tenuibus, distinctis, sub margine anastomosantibus; inflorescentiis terminalibus, paniculatis vel racemosis, paucifloris, 5 ad 6 cm longis, floribus 4-meris; sepalis orbicularis ad ovatis, in siccitate pallidis, chartaceis, rotundatis, concavis, 2 exterioribus 6 ad 7 mm longis, 2 interioribus usque ad 10 mm longis; petalis oblongis, rotundatis, circiter 17 mm longis et 8 mm latis, in siccitate brunneis; phalangibus in floribus ♂ 4, circiter 8 mm longis; pedunculis crassis, liberis, circiter 7 mm longis; antheris numerosis, sessilibus, ellipticis, 2-locellatis, longitudinaliter dehiscentibus, 0.5 mm longis, in capitulis reniformibus 4 mm diametro dispositis; pistilli rudimento fungiforme, circiter 4 mm longo.

Ng Chi Leng, *McClure 9457*, May 6, 1922, in forested ravines on the south slope of the mountain, the flowers greenish cream colored, slightly fragrant.

A strongly marked species, apparently not closely related to any other described form of the section *Discostigma*, well characterized by its slenderly nerved leaves, their margins distinctly revolute; its terminal, paniculate or racemose, few-flowered inflorescences; and its relatively large staminate flowers.

GARCINIA OLIGANTHA sp. nov.

Frutex 1.5 m altus, ramis ramulisque tenuibus, subolivaceis, ramis teretibus, ramulis acute angulatus, 1 mm diametro; foliis chartaceis, in siccitate pallidis, oblongo-ellipticis ad lanceolatis, 5 ad 9 cm longis, 1.5 ad 3.5 cm latis, perspicue obtuse acuminatis, basi acutis; nervis utrinque 5 vel 6, tenuibus, obscuris; petiolo 4 ad 12 mm longo; floribus ♀ axillaribus, solitariis, sessilibus vel brevissime pedicellatis; sepalis 4, inaequalibus, exterioribus orbiculari-ovatis, 2 ad 3 mm longis, interioribus ellipticis ad oblongo-ellipticis, 4 ad 5 mm longis, rotundatis; staminoidiis 12, partibus liberis 0.8 ad 1.2 mm longis, basi omnibus connatis cupula 1 mm alta formantibus; ovario 4-loculare, stigmate sessile, 2 mm diametro.

Ng Chi Leng, *McClure 8701*, December 1, 1921, on forested slopes, altitude about 700 meters.

A strongly marked species, well characterized by its rather thin, few-nerved, comparatively small leaves; its very slender branches and branchlets, the latter but 1 mm in diameter and sharply angled; and its sessile, solitary, pistillate flowers, the 12 staminodes being entirely united below into a cup, 1 mm high, surrounding the ovary. In its staminode characters it resembles *Garcinia hanburyi* Hook. f. and *G. gaudichaudii* Pl. & Tr., but is otherwise not closely allied to these species.

FLACOURTIACEAE

CASEARIA VILLILIMBA sp. nov.

Arbor parva, 4 ad 7 m alta, ramulis et subtus foliis molliter pubescentibus; foliis oblongo-ellipticis, chartaceis, olivaceis, 15 ad 20 cm longis, 6 ad 8 cm latis, acuminatis, basi acutis ad obtusis, margine minute denticulatis, supra glabris, subtus molliter pubescentibus, nervis utrinque circiter 9, perspicuis, curvatis, supra haud impressis, subtus paullo elevatis; petiolo 6 ad 10 mm longo; floribus fasciculatis, pedicellatis, sepalis persistentibus oblongo-ellipticis, obtusis, 3 mm longis, leviter pubescentibus,

pedicellis 4 ad 5 mm longis; fructibus oblongis, glabris, aurantiacis, in siccitate atris, 1 cm longis, obtusis, seminibus paucis.

Ng Chi Leng and Sha Po Leng, *McClure 9326* (type), *8160*, November 11, 1921, and April 28, 1922, on forested slopes and in damp ravines, altitude at and above 450 meters.

A species most closely allied to *Casearia philippinensis* Merr., from which, among other characters, it is distinguished by its differently shaped, fewer-nerved, denticulate leaves.

TARAKTOGENOS HAINANENSIS sp. nov.

Arbor circiter 6 m alta, glabra, ramis ramulisque teretibus; foliis oblongis, chartaceis vel subcoriaceis, in siccitate pallidis, nitidis, 9 ad 13 cm longis, 3 ad 5 cm latis, basi acutis, apice obtusis vel acuminatis, margine irregulariter distanterque undulato-serratis vel serrato-crenatis, nervis utrinque circiter 8, adscendentibus, tenuibus; petiolo 1 ad 1.5 cm longo; inflorescentiis in axillis superioribus subterminalibusque, brevibus, 1 ad 1.5 cm longis; floribus ♂ confertis, 4-meris; sepalis rotundatis, concavis, glabris, 4 mm diametro, submembranaceis; petalis reniformi-ovatis, 3 ad 3.5 mm latis, 2 ad 2.5 mm longis, ciliatis, squamulis crassis, ciliatis, irregulariter 4- ad 6-dentatis, quam petalis dimidio brevioribus; staminibus 12, filamentis crassis, 1 mm longis, leviter pubescentibus; antheris oblongis, 1.5 ad 2 mm longis.

Shui Mun, *McClure 9636*, May 15, 1922, on rocky stream banks.

This species is most closely allied to *Taraktogenos serrata* Pierre of Indo-China, from which it differs in its glabrous, not ferruginous-pubescent sepals, although in the present species the very young buds are sparingly pubescent. The genus is new to China.

MYRTACEAE

EUGENIA HAINANENSIS sp. nov. § *Eueugenia*.

Arbor circiter 25 m alta (fide McClure), ramulis et inflorescentiis et foliis junioribus cinereo-pubescentibus, partibus vetustioribus glabris vel subglabris; ramis brunneis, teretibus, laevis, glabris, ramulis distincte 4-angulatis, circiter 2 mm crassis; foliis oblongo-ellipticis, coriaceis, utrinque subaequaliter angustatis acutisque vel apice breviter acuminatis, 5 ad 8 cm longis, 1.5 ad 3 cm latis, supra olivaceis, nitidis, glabris vel junioribus puberulis, minutissime punctatis, subtus pallidioribus, margine minute revolutis, nervis utrinque 15 ad 20, tenuibus, obscuris, plerumque obsoletis vel subobsoletis; petiolo 7 ad 10 mm longo, puberulo; cymis axillaribus, pedunculatis, cinereo-pubes-

centibus, paucifloris, circiter 4 cm longis; floribus plerumque 5-meris, longe pedicellatis, pedicellis 10 ad 17 mm longis, bracteis binis crassis ellipticis ad spatulatis dense pubescentibus circiter 7 mm longis instructis, calycis tubo cinereo-pubescente, circiter 2 mm longo, haud vel obscurissime sulcato, lobis latissime ovatis ad reniformi-ovatis, 1 ad 1.5 mm longis; petalis ellipticis, circiter 6 mm longis, liberis, glandulosis, exterioribus extus minute pubescentibus.

Yik Tsok Mau, *McClure 9734*, May 19, 1922, in wooded ravines.

The specimen was originally identified as *Eugenia gracilenta* Hance, but presents little in common with that species and belongs in the section *Eueugenia* rather than in *Syzygium*. Specimens identified as *Eugenia gracilenta* Hance and distributed by the Hongkong Herbarium represent a *Decaspermum*.

MELASTOMATACEAE

SONERILA HAINANENSIS sp. nov.

Suffruticosa, erecta, 10 ad 20 cm alta, glabra vel superne pilis capitatis paucis instructa, caulis basi decumbens, 1.5 mm diametro, internodiis 5 ad 15 mm longis; foliis in paribus aequalibus vel subaequalibus dispositis, petiolatis, membranaceis, ellipticis ad late elliptico-ovatis, 1.5 ad 2.5 cm longis, 1 ad 2.3 cm latis, apice acutis ad rotundatis, basi rotundatis, 3-nerviis vel obscurissime 5-nerviis, reticulis obsoletis, margine distanter serratis, dentibus pilis capitatis terminantibus; petiolo 1 ad 2 cm longo; floribus terminalibus vel subterminalibus, plerumque solitariis, 3-meris, pedicellis calycibusque pilis capitatis paucis instructis, calycis cylindraceis, 5 mm longis, dentibus triangularibus, acutis, 1.5 mm longis; petalis oblongo-ellipticis, breviter acuminatis, 1 cm longis; antheris lanceolatis, breviter acuminatis, 1 cm longis.

Ng Chi Leng, *McClure 9391*, May 1, 1922, in thickets near the summit of the mountain, altitude about 1,600 meters.

A species apparently belonging in the group with *Sonerila rhombifolia* Thw., and *S. glaberrima* Arn. Among other characters it is rather strongly marked by its widely scattered capitate-glandular hairs on the younger parts of the stems, margins of the leaves, pedicels, and calyces, being otherwise wholly glabrous.

ERICACEAE

PIERIS RUBROVENIA sp. nov.

Frutex circiter 3 m altus, ramis glabris, ramulis junioribus obscure pubescentibus; foliis coriaceis, oblongis ad oblongo-

ellipticis, utrinque acutis, 4 ad 6 cm longis, 1.5 ad 2.5 cm latis, supra glabris, nitidis, subolivaceis, subtus pallidioribus, leviter pubescentibus; nervis utrinque circiter 7, subtus conspicuis, rubro-brunneis; petiolo 5 ad 7 mm longo; racemis axillaribus terminalibusque, usque ad 7 cm longis, leviter pubescentibus; floribus albidis, pedicellis 4 mm longis, leviter hirsutis; sepalis subliberis, glabris vel subglabris, oblongo-lanceolatis, 3 mm longis, acutis; corolla 7 mm longa, subcylindrica, extus parce hirsuta, lobis ovatis, subacutis, 1 mm longis; stylis 4 mm longis, glabris, filamentis minute pubescentibus, 3 mm longis, apice haud corniculatis, antheris 1.5 mm longis.

Ng Chi Leng, *McClure 9380,* May 1, 1922, in thickets in moss-covered soil at the summit of the mountain, altitude about 1,900 meters.

A species like *Pieris villosa* Hook. f. characterized by its filaments being non-corniculate. In general aspect it resembles *P. ovalifolia* D. Don, but differs not only in its staminal but also in its vegetative characters.

MYRSINACEAE

MAESA ACUMINATISSIMA sp. nov. § *Eumaesa.*

Frutex ut videtur scandens, glaber, prophyllis minutis, lanceolatis, haud cumbiformis; inflorescentiis terminalibus vel pseudo-terminalibus, bipinnnatin paniculatis, pyramidatis, 5 ad 7 cm longis, sepalis glaberrimis, haud lineatis; foliis lanceolatis, membranaceis, olivaceis, nitidis, glaberrimis, lineis nervilliformibus destitutis, 9 ad 12 cm longis, 2 ad 3 cm latis, integris vel undulatis, basi acutis, apice caudato-acuminatis, nervis utrinque 4 vel 5, distinctis, curvato-anastomosantibus, petiolo circiter 1 cm longo; paniculis e basi ramosis, ramis primariis paucis, patulis, inferioribus usque ad 3 cm longis, pedicellis tenuibus, 5 mm longis; fructibus subglobosis, circiter 3 mm diametro, haud lineatis vel punctatis, sepalis persistentibus triangularibus, acutis.

Ng Chi Leng, *McClure 8572, 9454* (type), in forested ravines, altitude about 1,400 meters.

A species perhaps belonging in the group with *Maesa pisocarpa* Blume, but, if so, then radically different from the other species placed here. Even if placed with those species characterized by lateral inflorescences, it is apparently widely different from any hitherto described form. Among the species with terminal inflorescences, the present one is characterized by its relatively small panicles which do not exceed 7 cm in

length, and is otherwise strongly characterized by its lanceolate, membranaceous, caudate-acuminate leaves and its slender elongated pedicels.

MAESA CONSANGUINEA sp. nov. § *Eumaesa.*

Frutex ut videtur scandens, glaber; prophyllis parvis, ovatis, haud cymbiformis; inflorescentiis axillaribus, solitariis, racemosis vel depauperato paniculatis, petiolo aequantibus vel paullo longioribus, sepalis haud ciliatis, haud lineatis; foliis membranaceis, oblongis ad oblongo-ovatis, olivaceis, nitidis, 7 ad 12 cm longis, 3 ad 6 cm latis, lineis nervilliformis praeditis, subcaudato-acuminatis, basi acutis ad rotundatis, margine integris vel leviter undulatis vel distanter denticulatis, nervis utrinque 5 vel 6, distinctis; petiolo 1 ad 1.5 cm longo; inflorescentiis plerumque circiter 1 cm longis, rariter 2.5 cm longis; fructibus subglobosis, breviter pedicellatis, 2.5 ad 3 mm diametro, sepalis 5, persistentibus, triangularibus, acutis.

Ng Chi Leng, *McClure 9468* (type) *9541,* May, 1922, in forested ravines on the south slope of the mountain.

A species allied to the Philippine *Maesa denticulata* Mez and to the Celebesian *M. warburgii* Mez, from both of which, among other characters, it is distinguished by its short inflorescences.

EBENACEAE

DIOSPYROS HAINANENSIS sp. nov.

Arbor 10 ad 18 m alta, subglabra, ramis teretibus, glabris, griseis, ramulis junioribus leviter hirsutis glabrescentibus; foliis coriaceis, oblongo-ellipticis, 10 ad 14 cm longis, 3.5 ad 6 cm latis, in siccitate pallidis, nitidis, obtusis ad obtuse acuminatis, basi acutis vel plerumque rotundatis, nervis utrinque circiter 9, subtus perspicuis, curvato-adscendentibus, anastomosantibus, reticulis supra obsoletis vel subobsoletis, subtus perspicuis; petiolo 1 ad 1.5 cm longo; floribus ignotis; fructibus ovoideis vel subglobosis, 3 ad 4 cm diametro, nigris, vetustioribus glabris, junioribus dense hirsutis, circiter 8-locellatis, pericarpio circiter 4 mm crasso; seminibus compressis, circiter 1.7 cm longis, albumine aequabile; calycis persistentibus crasse coriaceis, hirsutis, vetustioribus glabrescentibus, subquadratis, 2 ad 2.3 cm latis, late 4-lobatis, lobis subacutis.

Yik Tsok Mau and Ng Chi Leng, *McClure 8462* (type), *9320, 9748,* December, 1921, and April and May, 1922, in forested ravines up to 1,200 meters altitude. Local names: *Ngau kau shue, ngau kam muk, ngau kau muk, chai pat pat.*

The vegetative characters of this species are similar to those of *Diospyros peregrina* (Gaertn.) Gürke (*D. embryopteris* Pers.), from which it can be readily distinguished by its reticulations, although prominent on the lower surface, being obsolete on the upper surface, as well as in its very different persistent calyces.

DIOSPYROS MACLUREI sp. nov.

Arbor 12 ad 15 m alta, inflorescentiis fructibusque exceptis glabra, ramis teretibus, ramulis tenuibus; foliis coriaceis vel crasse chartaceis, oblongis ad late oblongo-oblanceolatis, 8 ad 12 cm longis, 3 ad 5 cm latis, nitidis, olivaceis vel brunneis, obtuse acuminatis, basi acutis, nervis utrinque circiter 8, subtus valde perspicuis, reticulis laxis; petiolo 8 ad 10 mm longo; floribus ♀ axillaribus, ut videtur fasciculatis vel breviter racemosis; fructibus oblongo-ovoideis vel subcylindraceis, 8-locellatis, junioribus dense ferrugineo-pubescentibus, vetustioribus glabris, nigris, circiter 5 cm longis et 3 cm diametro; seminibus paucis, 3 ad 3.5 cm longis, albumine aequabile; calycis persistentibus coriaceis, sub fructu circiter 2 cm diametro, ferrugineo-pubescentibus, ut videtur glabrescentibus, 4-lobatis, lobis suborbicularis, patulis vel reflexis, late rotundatis.

Yik Tsok Mau and Ng Chi Leng, *McClure 8657, 8463, 9643* (type), December, 1921, and May, 1922, on forested slopes and in ravines, altitude about 650 meters.

My specimen of *8463* is sterile, although the field note accompanying it indicates that the flowers are yellowish green; *9643* presents immature fruits, and *8657* fully matured fruits, lacking however the persistent calyces. The species is well characterized by its oblong or cylindric, apparently fleshy, ultimately glabrous fruits which are black when dry, as well as by its unusually long seeds.

SYMPLOCACEAE

SYMPLOCOS LANCILIMBA sp. nov.

Arbor parva, 4 ad 5 m alta, glabra, ramis ramulisque tenuibus, glabris, ramis subpurpureis, ramulis viridis, circiter 1 mm diametro; foliis lanceolatis, chartaceis, in siccitate viridis, utrinque concoloribus, 5 ad 7 cm longis, 1.5 ad 2.5 cm latis, caudato-acuminatis, basi acutis, margine obscure distanter glandulosodenticulatis vel integris, nervis utrinque circiter 4, distantibus, subtus perspicuis, arcuato-anastomosantibus, reticulis laxis, costa supra impressa; petiolo 2 ad 4 mm longo; inflorescentibus

axillaribus, simplicibus, racemosis, petiolo subaequantibus, plerumque 2- vel 3-floris; fructibus circiter 5 mm longis, oblongo-ovoideis, cylindraceis, glabris, pedicellis circiter 1 mm longis; bracteis et sepalis persistentibus parcissime pubescentibus.

Yik Tsok Mau, *McClure 9672,* May 18, 1922, in forested ravines.

This species in vegetative characters somewhat resembles *Symplocos modesta* Brand and *S. myrtacea* S. & Z., but differs totally from both in its very short, 2- or 3-flowered inflorescences which do not exceed the petioles in length.

SYMPLOCOS MACLUREI sp. nov.

Arbor circiter 10 m alta, ramis teretibus, glabris, ramulis inflorescentiisque densissime subferrugineo-tomentosis; foliis oblongis, 6 ad 9 cm longis, 2 ad 3 cm latis, chartaceis ad subcoriaceis, supra glabris, nitidis, viridis, subtus pallidis, subglaucescentibus, junioribus perspicue crispatulo-pilosis, vetustioribus glabris, perspicue acuminatis, basi acutis, margine subglanduloso-crenulatis, nervis utrinque 5 vel 6, subtus perspicuis, costa supra impressa; petiolo circiter 1 cm longo, piloso; spicis axillaribus, 5 ad 7 cm longis; fructibus sessilibus, oblongis, cylindraceis, 10 ad 12 mm longis, circiter 4 mm diametro, apice densissime villosis, bracteis dense villosis.

Ng Chi Leng, *McClure 9461,* May 6, 1922, in forested ravines.

A striking species, strongly characterized by the dense indumentum on the branchlets and the stout spikes; the strongly contrasted leaf surfaces, the upper being green and glabrous, except in very young leaves, the lower being pale, almost glaucous; and the conspicuous crisped indumentum which disappears in age. The cylindric fruits at full maturity are entirely glabrous except for the very densely tomentose apices, but the younger ones present the same type of indumentum in places on the sides, indicating that the very young fruits are densely tomentose.

SYMPLOCOS SCHAEFFERAE sp. nov. § *Bobua, Lodhra.*

Arbor 4 ad 5 m alta, inflorescentiis exceptis glaberrima, ramis teretibus, griseo-purpureis, ramulis flavidis, teretibus vel leviter compressis; foliis obovatis ad oblongo-obovatis, in siccitate flavidis, coriaceis, 4 ad 5 cm longis, 1.5 ad 5.5 cm latis, breviter abrupteque acuminatis, basi acutis, margine glandulosodenticulatis, nervis utrinque circiter 6, distantibus, distinctis, perspicue et laxe arcuato-anastomosantibus, costa supra leviter impressa; petiolo 5 ad 8 mm longo; inflorescentiis axillaribus,

spicatis, simplicibus, vel circiter basi rariter ramosis, 2.5 ad 6 cm longis, adpresse pubescentibus; bracteis adpresse pubescentibus, oblongis ad lanceolatis vel subspatulatis, acuminatis, inferioribus usque ad 5 mm longis, superioribus minoribus, bracteolis late ovatis, obtusis, 2 mm longis; floribus glaberrimis, calycis tubo brevissimo, lobis elliptico-ovatis, obtusis, 2 mm longis; petalis ellipticis, rotundatis, 4 mm longis; staminibus plus minusve pentadelphis, filamentis usque ad 6 mm longis.

Wong Chuk, en route to Kachek, *McClure 9781*, June 1, 1922, along roads.

A species superficially resembling *Symplocos urceolaris* Hance and probably belonging in the same group. It differs from Hance's species in its smaller, differently shaped leaves, and its strictly spicate, not racemose inflorescences. Following Brand's arrangement of the species in this section it falls in the group with *Symplocos khasiana* Brand and *S. foliosa* Wight, from both of which it is amply distinct. The species is dedicated to Miss K. L. Schaeffer of the American Presbyterian Mission in Hainan, whose botanical collections have added several species to the Hainan list, including at least one previously undescribed form.

LOGANIACEAE

FAGRAEA CHINENSIS sp. nov.

Frutex scandens, glaber, ramulis 4 ad 5 mm diametro; foliis oblongis ad ellipticis, olivaceis, chartaceis, 7 ad 13 cm longis, 3 ad 4.5 cm latis, acuminatis, basi acutis, nervis lateralibus obsoletis vel subobsoletis; petiolo 1 ad 3 cm longo; inflorescentiis terminalibus, brevibus, 1- vel 3-floris, brevissime pedunculatis, bracteolis ovatis ad lanceolatis, acuminatis, 4 mm longis; floribus circiter 6 cm longis, breviter pedicellatis, calycis 1 ad 1.8 cm longis, lobis ovatis ad orbiculari-ovatis, rotundatis; corollae tubo circiter 3.5 cm longo, sursum ampliato, lobis obovatis, 2.5 ad 3 cm longis; fructibus ovoideis, apiculato-acuminatis, nitidis, 4 cm longis, sepalis persistentibus chartaceis, patulis.

Yik Tsok Mau and Sha Po Leng, *McClure 9724* (type), *8187*, May 19, 1922, and November 11, 1921, in forested ravines. The same species is represented by *Hongkong Herbarium 440* from Tai Hang, Hongkong, June 28, 1893.

No representative of this genus has been hitherto recorded from China, the present species manifestly belonging in the group with, and closely allied to *Fagraea obovata* Wall., from which it differs in its much thinner, differently shaped leaves, 1- to 3-flowered inflorescences, and the persistent spreading

sepals. To be compared with the Formosan *Fagraea sasakii* Hayata.

APOCYNACEAE

EPIGYNUM CHINENSE sp. nov.

Frutex scandens, partibus junioribus parcissime pubescentibus, ramis ramulisque teretibus, laevis, ramulis 1 mm diametro; foliis oblongo-ovatis, membranaceis vel subchartaceis, olivaceis, 5 ad 7 cm longis, 2 ad 4 cm latis, acutis vel leviter acuminatis, basi obtusis vel subrotundatis, nervis utrinque 4 vel 5, tenuibus, distantibus, reticulis obsoletis vel subobsoletis, supra glabris, subtus ad costa parce adpresse pubescentibus, vetustioribus glabris; petiolo 2 ad 3 mm longo, adpresse pubescente; cymis in axillis superioribus, circiter 3 cm longis, tenuiter pedunculatis, sublaxis, plus minusve adpresse pubescentibus; floribus circiter 1.8 cm longis, calycis lobis elliptico-ovatis, obtusis, ciliatis, 1.2 mm longis, eglandulosis; corollae tubo 1.5 cm longo, deorsum glabro, sursum adpresse pubescente, in medio leviter ampliato, lobis orbiculari-ovatis, inaequilateralibus, obtusis, adpresse pubescentibus, 3 mm longis; antheris oblongis, 1.5 mm longis; discus crassus, circiter 1.2 mm altus, lobatus; folliculis linearis, 8 ad 11 cm longis, obscurissime torulosis, circiter 3 mm diametro, acuminatis, seminibus anguste lanceolatis, 1 ad 1.4 cm longis.

Yik Tsok Mau, Ng Chi Leng, and Nor Tai Shee, *McClure 9710* (type), *8606*, May 18, 1922, and December, 1921, and *Hongkong Herbarium 445 Chinese collector*, July 26, 1893, distributed as *Rauwolfia*. In forested ravines, altitude about 600 meters.

The first representative of the genus to be found in China, well characterized by its small leaves and flowers. In details of its flower it agrees closely with the characters of *Epigynum*, and I think is correctly placed here.

KOPSIA LANCIBRACTEOLATA sp. nov.

Arbor circiter 6 m alta, bracteis floribusque exceptis glabra, ramis teretibus, ramulis leviter compressis, circiter 3 mm diametro; foliis oblongis ad oblongo-ellipticis, coriaceis, 9 ad 12 cm longis, 4 ad 5.5 cm latis, nitidis, utrinque concoloribus, utrinque subaequaliter angustatis, apice breviter obtuse acuminatis, basi acutis, nervis utrinque 12 ad 15, tenuibus, distinctis; petiolo 5 ad 7 mm longo; inflorescentiis (floribus exceptis) circiter 5 cm longis, pedunculatis, parce ramosis, floribus ad apice ramulorum confertis, sessilibus; bracteis confertis, lanceolatis,

acuminatis, cinereo-puberulis, 7 mm longis; calycis lobis oblongo-lanceolatis, acutis, cinereo-puberulis, 6 mm longis; corollae tubo extus glabro, intus villoso, circiter 2.5 cm longo, ad apicem leviter dilatato, lobis oblongis, circiter 1.5 cm longis; antheris lanceolatis, acuminatis, 2 mm longis, fructibus subellipsoideis, circiter 2.5 cm longis, in siccitate olivaceis, rugosis, apice rotundatis.

Ka La, *McClure 9183*, April 20, 1922, in ravines.

A species belonging in the general group with *Kopsia fruticosa* A. DC., well characterized by its lanceolate, puberulent, relatively large bracts and calyx segments, the bracts and flowers being crowded in small groups at the tips of the few primary branches of the inflorescences. The genus is new to China.

ASCLEPIADACEAE

HOYA HAINANENSIS sp. nov.

Herbacea, scandens, petalis intus parce pubescentibus exceptis glabra, ramis teretibus, 1.5 ad 2 mm diametro; foliis in siccitate chartaceis, ovato-ellipticis, penninerviis, oppositis, 6 ad 8 cm longis, 2.5 ad 4 cm latis, utrinque subaequaliter angustatis, apice acuminatis, basi acutis, nervis utrinque circiter 4, tenuibus, obscuris, subobliquis, reticulis laxis, inconspicuis; petiolo 8 ad 10 mm longo; umbellis circiter 20-floris, pedunculo circiter 2 cm longo, pedicellis tenuibus, pedunculo subaequantibus; floribus albis, 8 ad 10 mm diametro, calycis lobis oblongo-ovatis, rotundatis, 1 mm longis, glabris, petalis oblongo-ovatis, acutis vel acuminatis, intus puberulis.

Ng Chi Leng, *McClure 9759*, May, 1922, on tree trunks, south slope of the mountain.

A species belonging in the same group with and apparently closely allied to *Hoya oblongacutifolia* Cost., of Indo-China, from which it can be distinguished by its somewhat smaller flowers, the sepals rounded and glabrous, not acute and ciliate.

HOYA OBSCURINERVIA sp. nov.

Subherbacea, scandens, petalis intus exceptis glabra, ramis teretibus, 3 ad 4 mm diametro; foliis oppositis, carnosis, in siccitate coriaceis, pallidis, ellipticis ad oblongo-ellipticis, subtenuiter acuminatis, basi plerumque acutis, obscure 3- vel 5-plinerviis, circiter 10 cm longis, 4 ad 4.5 cm latis, nervis tenuibus, reticulis obsoletis; petiolo crasso, 2 ad 2.5 cm longo; umbellis circiter 25-floris, longe pedunculatis, pedunculo circiter 8 cm longo, pedicellis tenuibus, 2 ad 2.5 cm longis; floribus albis, circiter 1 cm diametro, sepalis oblongo-ovatis, subacutis,

obscurissime ciliatis; petalis intus puberulis, ovatis ad oblongo-ovatis, acutis, circiter 4.5 mm longis.

San Tsuen, near Nodoa, and Loh Hoe, *McClure 9819* (type) *Moninger 164*, April 15, 1922, and May, 1919, on trees in village commons.

The alliance of this species is clearly with *Hoya parasitica* Wall., from which it is distinguished, among other characters, by its longer petioles and distinctly larger flowers. Local name: *Ah meung hai.*

VERBENACEAE

TSOONGIA genus novum

Calyx parvus, campanulatus, extus granuloso-glandulosis, subbilabiato-3-dentatus. Corollae tubus elongatus, cylindraceus, sursum leviter ampliatus, fauce haud barbatus, limbus sub patens, subaequaliter 4- vel 5-lobatus, lobis late ovatis, quam tubo multo brevioribus; stamina 4, subaequalia, medio tubo affixa, leviter exserta; ovarium 2-loculare, loculis 2-ovulatis; stylus elongatus, integer, stigmate punctiforme.—Frutex erectus, leviter pubescente; foliis oppositis, integerrimis, subtus obscure punctato-glandulosis, longe petiolatis; inflorescentiis axillaribus, cymosis, laxis, paucifloris, cymis quam petiolis brevioribus; floribus parvis, aurantiacis.

TSOONGIA AXILLARIFLORA sp. nov.

Frutex erectus, 4 ad 5 m altus, ramis teretibus, subpurpureis, glabris, ramulis ferrugineo-pubescentibus; foliis membranaceis, oblongo-ovatis ad elliptico-ovatis, 6 ad 10 cm longis, 3 ad 5 cm latis, acuminatis, basi rotundatis ad subacutis, supra olivaceis vel atro-olivaceis, nitidis, glabris vel ad costa pubescentibus, subtus pallidioribus, subbrunneis, obscure puncticulatis, ad costa nervisque plus minusve pubescentibus; nervis utrinque 6 vel 7, tenuibus, subtus perspicuis, curvatis, anastomosantibus; petiolo 2 ad 3 cm longo, pubescente; cymis breviter pedunculatis, 1 ad 2 cm longis, paucifloris, bracteis linearis, vix 1 mm longis; calycis subcampanulatis, 2.5 ad 3 mm longis, 2-labiatis, labio altero ovato, rotundato, 1.5 mm lato et 1 mm longo, integro, altero bidentato, dentibus ovatis, acutis; corollae tubo 9 mm longo, extus granuloso-glanduloso, subaequaliter 4- vel 5-lobato, lobis late ovatis, rotundatis, 2 mm longis; filamentis glabris, leviter exsertis, antheris 1 mm longis.

Yik Tsok Mau, *McClure 9692*, May 18, 1922, in forested ravines. The same species is represented by *K. K. Ts'oong*

1908, from Kwangtung Province, China, localized as Yam Chow, the genus being dedicated to this collector, Professor Ts'oong (Chung) Kwan Kwong of Peking University.

Tsoongia is most closely allied to *Premna,* and is somewhat intermediate between *Vitex* and *Premna,* although distinctly closer to the former. It differs notably from *Vitex* in its subequally 4- or 5-lobed corollas which are not bilabiate, and from *Premna* in its slender, elongated corolla tubes, its strictly axillary inflorescences, its glabrous corolla throats, and its entire styles. In *Premna* the corolla tubes are short and broad, while the inflorescences are strictly terminal, except in a single species, *P. cauliflora* Stapf. In the present genus the corolla throats are not bearded, the tube being glabrous within except for a few hairs below the insertion of the filaments.

SOLANACEAE

SOLANUM DEBILISSIMUM sp. nov.

Herba prostrata, vix ramosa, usque ad 60 cm longa, caulis 1 ad 1.5 mm crassis, sulcatis, parce pilosis, nodis plerumque radicantibus; foliis membranaceis, oblongo-ovatis, utrinque sparse sed perspicue crispatulo-pilosis, plerumque in paribus inaequalibus, minoribus usque ad 2.5 cm longis et 1.5 cm latis, majoribus usque ad 6 cm longis et 2.5 cm latis, basi rotundatis, apice acutis ad acuminatis, nervis utrinque 4 ad 6, tenuibus, obscuris; floribus axillaribus, solitariis, purpureis, pedicellis usque ad 1 cm longis; calycis crispatulo-pilosis, 4 mm diametro, 10-lobatis, lobis linearis, patulis, 2 ad 3 mm longis; corollae tubo 1.5 mm longo, lobis lanceolatis, membranaceis, 6 ad 7 mm longis, acuminatis, parce ciliatis; antheris oblongo-ovatis, 3 mm longis; fructibus globosis, carnosis, laevis, glabris, rubris, circiter 6 mm diametro, seminibus paucis (circiter 6), compressis, reniformi-ovatis, 2 mm longis, obscure denseque reticulatis.

Ng Chi Leng, *McClure 9532,* May 11, 1922, along the margins of streams in forested ravines.

A species allied to *Solanum biflorum* Lour., but totally different from that species in its habit, as well as in numerous other characters.

RUBIACEAE

ARGOSTEMMA DISCOLOR sp. nov.

Herba simplex vel ramosa, 7 ad 12 cm longa, erecta vel deorsum procumbens, ramis hirsutis; foliis in paribus valde

inaequalibus, chartaceis, supra olivaceis, sparse hirsuto-spinulosis, praesertim ad costa et circiter margine, subtus pallidis, albidis vel subferrugineis, costa nervisque densissime subpapilloso-hirsutis, majoribus ellipticis, utrinque acutis vel obtusis, 1 ad 2 cm longis, 10 ad 14 cm latis, nervis utrinque circiter 5, tenuibus, distinctis, minoribus ovatis ad orbiculari-ovatis, 5 ad 8 mm longis; stipulis ovatis ad orbiculari-ovatis, 2 ad 4 mm longis, integris; floribus 5-meris, tenuiter pedicellatis, plerumque solitariis, pedicellis pilosis, circiter 2.5 cm longis; calycis tubo circiter 2.5 mm longo, adpresse piloso, lobis triangulari-ovatis, acuminatis, circiter 1.5 mm longis; petalis lanceolatis, acuminatis, 6 ad 7 mm longis; antheris 7 mm longis, lanceolatis.

Ng Chi Leng, *McClure 9408*, May 3, 1922, on moist, shaded rock faces and in fertile, shaded nooks on the south slope of the mountain.

A species very similar and closely allied to *Argostemma hookeri* King of the Malay Peninsula, differing in numerous details.

HEDYOTIS OLIGANTHA sp. nov.

Frutex erectus, circiter 30 cm altus, ramosus, ramis ramulisque teretibus, ramulis dense breviter sordide pubescentibus, circiter 1 mm diametro; foliis subellipticis, olivaceis, 1 ad 2 cm longis, 8 ad 11 mm latis, chartaceis, utrinque subaequaliter angustatis, breviter acute acuminatis, basi acutis, utrinque glabris vel subtus ad costa obscure puberulis, nervis utrinque circiter 3, tenuibus, obscuris, curvato-adscendentibus, reticulis obsoletis; petiolo circiter 2 mm longo; stipulis ovatis, pubescentibus, apice trifidis, lobis angustis, brevibus; floribus terminalibus vel in axillis superioribus, paucis, plerumque solitariis vel binis, sessilibus, circiter 15 mm longis, calycis tubo ovoideo, 2 mm longo, leviter pubescente, lobis 5, anguste lanceolatis, 3 ad 3.5 mm longis; corollae tubo cylindrico extus glabro, 8 mm longo, intus dense barbato, lobis oblongo-lanceolatis, 4 mm longis; antheris inclusis, 1.8 mm longis.

Ng Chi Leng, *McClure 9401*, May 1, 1922, in dense forests near the summit of the mountain, altitude about 1,900 meters.

A species belonging in the same general group with the Philippine *Hedyotis macgregorii* Merr., but differing from that species in numerous details, especially in its smaller, glabrous, acutely acuminate, fewer-nerved leaves; terete, not 4-angled branchlets; and very different flowers.

MORINDA TRICHOPHYLLA sp. nov.

Frutex alta scandens, perspicue villosus, ramis ramulisque teretibus, dense ferrugineo-villosis; foliis oblongis ad oblongo-ellipticis, chartaceis, 7 ad 12 cm longis, 3 ad 5 cm latis, supra olivaceis, subtus pallidioribus, supra sparse hirsutis, subtus perspicue villosis, apice subcaudato-acuminatis, basi rotundatis vel obscure cordatis, nervis utrinque 10 ad 12, subtus valde perspicuis; petiolo villoso, 6 ad 8 mm longo; stipulis tubulosis, vaginantibus, pilosis, usque ad 1 cm longis, truncatis, appendicibus binis filiformibus 5 mm longis terminatis; inflorescentiis terminalibus, capitulis (plerumque 5) 6 ad 8 mm diametro subumbellatim dispositis, pedunculis villosis, 2 ad 2.5 cm longis; calycis liberis, tubo plus minusve pubescente, 2 ad 2.5 mm longo, irregulariter 4-lobato, lobis lanceolatis ad lineari-lanceolatis, curvatis, 1 ad 4 mm longis; corolla 5 mm longa, tubo 2 mm longo, lobis crassis, valvatis, oblongo-ovatis, 2 mm longis, extus sparse pubescentibus, intus dense villosis; antheris oblongis, 1.4 mm longis.

Yik Tsok Mau, *McClure 8755* (type), *9668*, May 17 and 19, 1922, climbing in large trees in partly forested ravines.

A species strongly characterized by its indumentum and its slenderly acuminate leaves, strikingly different from all other species known to me. While in anthesis the calyces are free; still, I believe that the present species is correctly placed in *Morinda*, although fruiting material may show that some other generic disposition may be necessary.

MUSSAENDA MEMBRANIFOLIA sp. nov.

Frutex scandens, ramis ramulisque glabris, teretibus, tenuibus; foliis membranaceis, lanceolatis, olivaceis, 9 ad 15 cm longis, 2.5 ad 3.5 cm latis, utrinque subaequaliter angustatis, apice tenuiter acute subcaudato-acuminatis, basi cuneatis, utrinque, praesertim ad costa nervisque, parce adpresse breviter hirsutis, nervis utrinque circiter 9, distinctis, tenuibus, curvato-adscendentibus; stipulis bifidis, segmentis filiformibus, 3 ad 4 mm longis, parce adpresse hirsutis; inflorescentiis terminalibus, pedunculatis, laxis, plerumque 3-ramosis, floribus exceptis glabris vel subglabris, ramis patulis, tenuibus, circiter 2 cm longis; bracteis filiformibus, 5 mm longis; floribus paucis, breviter pedicellatis, bracteolis filiformibus, obscure hirsutis, circiter 3 mm longis, calycis tubo glabro, lobis filiformibus, circiter 4 mm longis, ut videtur persistentibus tubo subaequantibus, una maxima petio-

lata albida, membranacea, ovata, usque ad 3 cm longa et 2 cm lata, acuminata, utrinque ad nervis adpresse-hirsuta; corollae tubo saltem 7 mm longo, extus parcissime adpresse hirsuto, lobis cinereo-hirsutis, lanceolatis, acuminatis, saltem 4 mm longis.

Ng Chi Leng, *McClure 9316*, April 28, 1922, in forested ravines on the south slope of the mountain.

A species belonging in the group with *Mussaenda membranacea* King, of the Malay Peninsula, but certainly distinct from that imperfectly known one.

RANDIA CAUDATIFOLIA sp. nov.

Arbor glabra, circiter 10 m alta, ramis ramulisque teretibus, tenuibus, atro-brunneis, laevis; foliis lanceolatis, membranaceis ad chartaceis, in siccitate olivaceis vel castaneis, nitidis, 10 ad 15 cm longis, 2.5 ad 3.5 cm latis, basi cuneatis, apice longissime caudato-acuminatis, nervis utrinque 5 vel 6, tenuibus, distinctis, curvato-adscendentibus; petiolis 5 ad 7 mm longis; stipulis lanceolatis, tenuiter acuminatis, 3 ad 4 mm longis; cymis axillaribus vel oppositifoliis, 4 ad 5 cm longis, breviter pedunculatis, laxis, partibus junioribus obscure pubescentibus; calycis circiter 2.5 mm longis, breviter lobatis, lobis late ovatis, obtusis vel rotundatis, haud 0.5 mm longis; corollae tubo circiter 1 mm longo, lobis oblongis, junioribus 4 mm longis.

Ng Chi Leng, *McClure 9439* (type), *9564*, May 5 and 13, 1922, in forested ravines and on forested slopes on the south side of the mountain.

A species belonging in the group with and closely allied to *Randia racemosa* (Cav.) F.-Vill., to which the Chinese form currently referred to *Randia densiflora* Benth. is probably to be reduced. It is differentiated especially by its slenderly caudate-acuminate leaves, the acumen being up to 2 cm in length.

THE COMPOSITION OF PILI-NUT OIL

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INTRODUCTION

Several species of the genus *Canarium* bear edible nuts which have a fine flavor and yield a valuable oil. According to Lewkowitsch,[1] Java almond oil is obtained from the seeds of *Canarium commune,* which is a tree indigenous to the Moluccas and Malabar. It is cultivated in tropical Asia, where the seeds serve as a foodstuff in place of sweet almonds.

Canarium oleosum and *Canarium polyphyllum* also yield seeds very similar to those obtained from *Canarium commune.*

Pastrovich[2] examined the oil obtained from the seeds of *Canarium commune.* When subjected to pressure the seeds yield 56.1 per cent of oil which is pale yellow and has a pleasant taste. On standing "stearine" separates out at 15° C. The percentage of unsaponifiable matter in the oil was found to be 0.44. The fatty acids separated by the lead-salt-ether method consist of 44.6 per cent saturated acids and 55.4 per cent unsaturated acids. The saturated acids contained palmitic and stearic acids. The unsaturated acids gave no hexabromides, showing the absence of linolenic acid. The fatty acids consist approximately of 44.6 per cent palmitic and stearic acids, 43 per cent oleic acid, and 12.5 per cent linolic acid.

In the Philippines, oil obtained from the seeds of *Canarium ovatum* is known as pili-nut oil. *Canarium ovatum* is a tree which reaches a height of about 20 meters and a diameter of

[1] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 2 (1913) 382.

[2] Pastrovich, P., Chem. Zeit. 31 (1907) 782.

40 centimeters. This species is very abundant in southern Luzon. The fruits are 6 to 7 centimeters in length and consist of hard, thick-shelled triangular nuts surrounded by a small amount of pulp. This pulp, which is edible when cooked, also contains an oil that is occasionally extracted locally and used for lighting and cooking.

Pili nuts are rich in oil and when roasted have a delicious flavor. They are used in making confections and, by many, are considered superior to almonds. Pili-nut oil is light yellow, has an agreeable odor and taste, and is suitable for culinary purposes. The keeping quality of the oil is very good, as shown by the fact that a sample stored for about six months had no rancid taste or odor and the acid value was only 1.42. It is said [3] that an average tree produces about 33 kilograms of pili nuts in one year.

Brill and Agcaoili [4] analyzed the kernels of pili nuts and determined the constants of the oil. Their results showed that the kernels contain about 74 per cent of fat and that the oil has an iodine value of about 59 to 61 and a saponification value of 186 to 192.

SAMPLE

The sample of pili-nut oil used in this investigation was obtained from pili nuts purchased in one of the markets in Manila. The hard shell of the nuts was broken with a hammer. The kernels were removed and ground into a meal, which was placed in a small press and the oil separated from the oil cake. When the oil was allowed to stand a few hours a small amount of "stearine" separated out. This was removed by filtration and the clear oil stored in glass-stoppered bottles. The constants of this sample of pili-nut oil are given in Table 1.

TABLE 1.—*Constants of pili-nut oil.*

Specific gravity $\frac{30°}{4°}$	0.9069
Refractive index at 30°	1.4646
Iodine value (Hübl)	55.9
Saponification value	197.4
Acid value	1.42
Unsaponifiable matter (per cent)	0.19

[3] West, A. P., and Brown, W. H., Bull. Philip. Bureau Forestry 20 (1920) 114.

[4] Brill, H. C., and Agcaoili, F., Philip. Journ. Sci. § A 10 (1915) 114.

In investigating the composition of pili-nut oil the saturated and unsaturated acids, which are present as glycerides in the oil, were separated by the lead-salt-ether method.[5] The unsaturated acids were determined by means of the bromo-derivative method.[6] The saturated acids were converted into their methyl esters [7] which were fractionally distilled. The composition of the saturated acids was estimated by calculating the data obtained from the methyl esters.

SEPARATION OF SATURATED AND UNSATURATED ACIDS

The lead-salt-ether method does not give a complete separation of saturated and unsaturated acids, since the saturated acids are always contaminated by a small quantity of unsaturated acids, as shown by the iodine value of the saturated acids. The unsaturated acids are also likely to be contaminated with a small quantity of saturated acids, but this error can usually be reduced to an unappreciable amount by not washing very thoroughly with ether the lead salts of the saturated acids.

In separating the saturated and unsaturated acids by the lead-salt method the unsaponifiable matter originally present in the oil goes with the unsaturated acids.[8] The percentage of impure unsaturated acids, as determined, must therefore be corrected, not only for the small amount of unsaturated acids present in the saturated acids, but also for the unsaponifiable matter which they contain. Since pili-nut oil contained only 0.19 per cent of unsaponifiable matter (Table 1), it was not considered necessary to correct the unsaturated acids for this small percentage of unsaponifiable as this slight correction may be applied directly to the unsaturated glycerides, thus giving the same result.

The percentage of impure saturated acids separated by the lead-salt method was 51.45, and the percentage of unsaturated acids, 43.87. The iodine value of the impure saturated acids was 23.32, and of the unsaturated acids, 89.92. The percentage

[5] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 556.

[6] Ibid. 1 (1921) 585.

[7] Jamieson, G. S., and Baughman, W. F., Journ. Am. Chem. Soc. 42 (1920) 1200.

[8] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 584; Baughman, W. F., and Jamieson, G. S., Journ. Am. Chem. Soc. 43 (1921) 2697.

of unsaturated acids present as contamination in the impure saturated acids [9] was 13.34.

$$\frac{51.45 \times 23.32}{89.92} = 13.34$$

The percentage of pure saturated acids was 51.45 — 13.34, or 38.11. The total percentage of unsaturated acids corrected for the unsaturated acids which were present as contamination in the impure saturated acids was 43.87 + 13.34, or 57.21.

The results of separating the saturated and unsaturated acids in pili-nut oil are given in Table 2.

TABLE 2.—*Separation of saturated and unsaturated acids in pili-nut oil by the lead-salt-ether method.*

	Per cent.
Impure saturated acids (determined)	51.45
Unsaturated acids and unsaponifiable matter (determined)	43.87
Total	95.32
Iodine value (Hübl) of unsaturated acids	89.92
Iodine value (Hübl) of impure saturated acids	23.32
Unsaturated acids present in the impure saturated acids (calculated)	13.34
Saturated acids corrected for unsaturated acids (calculated)	38.11
Unsaturated acids corrected for the unsaturated acids present in the saturated acids	57.21

UNSATURATED ACIDS

The iodine value of the unsaturated acids, separated by the lead-salt method, was found to be 89.92 (Table 2). Since the iodine value of oleic acid is 90.07, the result obtained indicates that the unsaturated acids consist entirely of oleic acid. To obtain confirmatory data the unsaturated acids were determined by means of the bromo-derivative method, which is used to separate and identify the unsaturated acids that may be present.

The bromine addition products of the unsaturated acids were prepared by dissolving a portion of the unsaturated acids (2.1368 grams) in ether; the ethereal solution was cooled to a

[9] Baughman, W. F., Brauns, D., and Jamieson, G. S., Journ. Am. Chem. Soc. 42 (1920) 2398.

temperature of —10° and bromine was added slowly, after which the solution was allowed to stand about three hours at —10°. No crystals of linolenic hexabromide, which is insoluble in ether, were obtained. This indicated that pili-nut oil contained no linolenic glyceride. The ethereal solution was then treated with 10 per cent sodium thiosulphate solution, to remove the excess of bromine. This treatment was repeated, to remove the last traces of bromine, after which the separated ethereal solution was dehydrated with anhydrous sodium sulphate, filtered, and distilled to eliminate the ether. The residue was then treated with petroleum ether (boiling point, 35° to 55°) and heated (reflux) for about a half hour. The petroleum ether solution was then cooled and allowed to stand several hours. No crystals of linolic tetrabromide were obtained. The solution was concentrated, by distilling, to a volume of about 200 cubic centimeters, cooled, and allowed to stand several hours, but still the tetrabromide did not crystallize. This indicated that, if the oil contained linolic glyceride, the percentage was probably small. The petroleum ether solution was concentrated to a volume of about 100 cubic centimeters, transferred to a small distilling flask, and the petroleum ether eliminated by distilling under diminished pressure. The dry residue (3.3540 grams) was weighed and the bromine content determined by boiling about 0.1 gram with about 0.5 gram of solid silver nitrate and 30 cubic centimeters of pure concentrated nitric acid. The precipitated silver bromide was then collected on a Gooch filter. The bromine content of the residue was found to be 36.03 per cent. Since oleic dibromide contains 36.18 per cent bromine the unsaturated acids consist entirely of oleic acid. The unsaturated acids separated by the lead-salt method and corrected for the unsaturated acids, which were present as impurity in the impure saturated acids, amounted to 57.21 per cent (Table 2). This is equivalent to 59.78 per cent of oleic glyceride which, according to the analysis, is the only unsaturated glyceride present in the oil.

Since the unsaponifiable matter (0.19 per cent, Table 1) present in the oil goes with the unsaturated acids in the lead-salt separation, the percentage of oleic glyceride corrected for unsaponifiable matter is 59.78 — 0.19, or 59.59.

The data obtained by analyzing the bromo-derivatives of the unsaturated acids are given in Table 3.

TABLE 3.—*Analysis of unsaturated acids.*

Sample of unsaturated acids (grams)	2.1368
Linolenic hexabromide insoluble in ether	----------
Linolic tetrabromide insoluble in petroleum ether	----------
Residue (grams)	3.3540
Bromine content of residue (determined) (per cent)	36.03
Oleic acid equivalent to dibromide (grams)	2.1400
Impure oleic glyceride in oil (per cent)	59.78
Oleic glyceride corrected for unsaponifiable matter (per cent)	59.59

SATURATED ACIDS

The impure saturated acids were converted into their methyl esters by dissolving the acids in methyl alcohol and saturating the solution with dry hydrogen chloride, which was prepared by treating fused ammonium chloride with sulphuric acid and passing the gas through sulphuric acid. The mixture was then heated on a water bath (reflux) for fifteen hours, after which it was treated with water and the ester layer separated. The esters were dissolved in ether and the ethereal solution washed with sodium carbonate solution and afterwards with water. The ethereal solution was then dehydrated with anhydrous sodium sulphate, filtered, and the ether removed by distilling. The impure esters (43.8832 grams), which were yellow, were distilled under diminished pressure. A preliminary distillation at about 15 millimeters pressure was made, to obtain the pure colorless esters and eliminate the dark impurities which were formed as by-products in the esterification process. The colorless esters (39.5476 grams) were then redistilled at 15 millimeters pressure. Data on the distillation of the esters are given in Table 4.

TABLE 4.—*Distillation of the impure methyl esters of the saturated acids; pressure, 15 millimeters.*

	Grams.
First distillation:	
Esters distilled, boiling point 195 ° to 210°C	43.8832
Distillate	39.5476
Residue	4.3356
Second distillation: Esters distilled	39.5476

Fraction.	Grams.	Saponification value.	Iodine value (Hübl).	Boiling point.
				°C.
I	19.1886	204.5	15.35	195.8–198.3
II	16.4020	201.5	21.53	198.3–209.7
Residue	3.9570	----------	----------	----------

The iodine values of the two fractions of methyl esters obtained in the second distillation (Table 4) show that these esters were contaminated with methyl oleate, since olein was found to be the only unsaturated glyceride in the oil. The percentage of unsaturated esters (methyl oleate) in each fraction of the impure esters was calculated from the iodine value. The saponification values and mean molecular weights of the esters of the saturated acids, uncontaminated with unsaturated esters, were then calculated, after which the composition of each fraction of the impure methyl esters was determined. The results are recorded in Table 5.

TABLE 5.—*Composition of methyl esters.*

Methyl esters of acids (second distillation).	Fractions.	
	I	II
	Per cent.	*Per cent.*
Oleic	17.89	25.09
Palmitic	82.11	67.45
Stearic		7.46
Total	100.00	100.00

Acids, equivalent to esters.	Fractions.		Total.
	I	II	
	Grams.	*Grams.*	*Grams.*
Oleic	3.27	3.92	7.19
Palmitic	14.94	10.49	25.43
Stearic		1.17	1.17

The saponification value of the saturated esters in the first fraction (Table 5) was 207.8, and the mean molecular weight, 270. Since the molecular weight of methyl palmitate is 270.3, the pure saturated esters in the first fraction consisted entirely of methyl palmitate. The saponification value of the saturated esters in the second fraction was 205.5, and the mean molecular weight, 273.1. Since the mean molecular weight is between the molecular weights of methyl palmitate (270.3) and methyl stearate (298.4), the saturated esters consist of a mixture of these two esters. Knowing the weights of the esters in each fraction (Table 4) and the composition of each fraction, the quantity of acids equivalent to the methyl esters was obtained (Table 5), after which the total percentage of saturated glycerides present in the original oil was calculated (Table 6). In making these various calculations the method adopted by Baughman and Jamieson in their investigation of Hubbard

squash-seed oil[10] was, in general, used and the following data were employed:

Molecular weight of potassium hydroxide	56.1
Iodine value of methyl oleate	85.81
Saponification value of methyl oleate	189.5

TABLE 6.—*Calculation of saturated acids to glycerides originally present in the oil.*

Acid.	Mixture of saturated acids.		Saturated acids calculated on basis of original oil.	Saturated glycerides in original oil.
	Grams.	*Per cent.*	*Per cent.*	*Per cent.*
Palmitic	25.43	95.60	36.43	38.25
Stearic	1.17	4.40	1.68	1.76
Total	26.60	100.00	38.11	40.01

As shown by the data given in Table 6, palmitin and stearin are the only saturated glycerides present in the oil.

In calculating the composition of the saturated acids the residues obtained in distilling the methyl esters were not considered. Since the esters seemed to decompose somewhat during the distillation, it was thought that the data obtained by analyzing the impure residues would not really represent the properties of the pure esters. There is, of course, a possibility that these residues contained other esters, in addition to those recorded. Considering the temperatures of the distillates and the experimental observations this would, however, appear to be unlikely.

SUMMARY

Pili-nut oil is an edible oil which has good keeping qualities and the following composition:

Constituent.	Per cent.
Oleic glyceride	59.6
Palmitic glyceride	38.2
Stearic glyceride	1.8
Unsaponifiable matter	0.2
Total	99.8

We wish to express our thanks and appreciation to Mr. Arthur F. Fischer, director of the Philippine Bureau of Forestry, for the material which he kindly supplied for this investigation and the assistance he has given.

[10] Baughman, W. F., and Jamieson, G. S., Journ. Am. Chem. Soc. 42 (1920) 156.

EFFECT OF COMPOSITION ON THE COMPLETE HYDROGENATION OF SOME PHILIPPINE OILS WITH NICKEL CATALYST

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ONE PLATE AND THREE TEXT FIGURES

INTRODUCTION

In recent years the demand for edible oils has been steadily increasing. As a result of this tendency, efforts have been made to convert oils that were formerly used in the manufacture of soaps and candles into edible oils, which are considerably more valuable. The method that has proved most successful is known as hydrogenation. The process consists in converting fatty oils, which are liquid at ordinary temperatures, into hard, solid fats. The liquid fats contain liquid unsaturated glycerides. When they are treated with hydrogen in the presence of a catalyst, these unsaturated substances are converted into solid saturated compounds. The hydrogenation process has been used successfully for making edible fats, like artificial butters (margarine) and lard substitutes, and also for preparing fats suitable for the soap and candle industries. This process will, no doubt, encourage the investigation and production of new oils that can be converted into edible products.

Hydrogenation plants have been operating for some years in various European countries and the United States, and recently one was built in Manila. According to Krebs [1] the hydrogenating vessel which is used in the technical process of hydrogenation has a capacity of from 1 to 30 barrels of oil. This is filled with oil to the specified capacity. The oil contained in the vessel is heated to the required temperature, and the catalyst,

[1] Krebs, A. W., Chemical Age 29 (1921) 315.

suspended in a small amount of oil, is pumped in. The circulating or agitating device is set in motion, and hydrogen gas then allowed to enter the oil. The progress of hydrogen absorption is ascertained by testing samples for the melting point. When the desired degree of saturation has been attained the oil is filtered through a press to eliminate the catalyst. The same catalyst is used a number of times, depending upon the quality of product desired.

A review of the literature [2] on this subject indicates that nickel is one of the best metallic catalysts and, when employed in hydrogenating oils, a concentration of about 2 per cent is commonly used. Increase in the percentage of nickel catalyst tends to increase the velocity of hydrogen absorption. The most-appropriate temperature for reducing a nickel catalyst, before using it in hydrogenating oils, is about 300°. The catalyst appears to work best when supported on some porous material like infusorial earth, which presents a large active surface of finely divided metal. The most-satisfactory temperature for hydrogenating oils is about 180°, and the velocity of hydrogenation is accelerated by introducing the hydrogen gas into the oil under pressure.

Very little has been written concerning the complete hydrogenation of vegetable oils with a nickel catalyst. Ellis mentions a few instances where oils have been almost completely hydrogenated or reduced to products which gave exceedingly low iodine values. Cotton-seed oil was reduced with a nickel catalyst by Normann and Pungs [3] until the resulting product had an iodine value of only 3.85. Norman and Hugel [4] obtained a sample of hydrogenated castor oil that had an iodine value of 4.8, and Boomer [5] reports a sample of coconut oil that showed an iodine value of 1. Olive, almond, peanut, sesame, poppy, and linseed oils were completely hydrogenated by Mannich and Thiele,[6] but they used 2 per cent palladium as a catalyst.

In view of the apparent scarcity of data on this subject we thought it might, perhaps, be of interest to hydrogenate com-

[2] Ellis, C. E., The Hydrogenation of Oils (1919); Henderson, G. G., Catalysis in Industrial Chemistry (1919); Maxted, E. B., Catalytic Hydrogenation and Reduction (1919); Rideal, E. K., and Taylor H. S., Catalysis in Theory and Practice (1919).

[3] Ellis, C. E., The Hydrogenation of Oils (1919) 201.

[4] Ibid. (1919) 284.

[5] Ibid. (1919) 290.

[6] Ibid. (1919) 310.

pletely some Philippine oils with a nickel catalyst and compare the results obtained by experiment with the theoretical results estimated from the composition of the oils. As the results obtained were satisfactory, it may be of interest to describe in detail the hydrogenation apparatus and the experimental procedure we used. In these experiments on the catalytic hydrogenation of Philippine oils we varied both the interval of time and the concentration of the catalyst.

METHOD AND APPARATUS

Although a large amount of experimental work has been done on the catalytic hydrogenation of oils, much of the literature on this subject is in the form of technical patents which give only a very brief and inadequate description of the hydrogenation process. Not a great deal has been written concerning the experimental details of simple laboratory methods of catalytic hydrogenation which would enable us to ascertain readily the comparative absorption of hydrogen by different kinds of oils.

The method employed in this investigation was similar to that generally used in hydrogenating nonvolatile oils. The oil containing the catalyst was stirred thoroughly, while hydrogen gas was passed into the agitated mixture, which was heated to a temperature of 180°.

The hydrogen gas was prepared by treating chemically pure zinc with dilute sulphuric acid. The gas was purified by passing through a Drechsel wash bottle containing dilute potassium hydroxide solution, and through another containing fairly concentrated potassium permanganate solution, after which it was passed through four cylinders containing anhydrous, granular calcium chloride, and finally into the vessel containing the mixture of oil and catalyst.

Before reduction, the catalyst consisted of a mixture of precipitated nickel carbonate and infusorial earth. It was prepared by dissolving 400 grams of recrystallized nickel nitrate in water and adding 90 grams of infusorial earth, after which a solution containing 180 grams of powdered sodium carbonate was added. The mixture was stirred thoroughly, and filtered. The residue was washed thoroughly until free from carbonate, spread out on a porous plate, and heated in an electric oven at a temperature of 80° until dry, after which the dried material was powdered and kept in a glass-stoppered bottle until ready for use. Since the composition of precipitated nickel carbonate varies somewhat according to the method of preparation, and usually

a portion is lost in manipulation, the exact nickel content of the catalyst was ascertained by analysis.

The catalyst was analyzed by decomposing it with hydrochloric acid, evaporating, and dehydrating the soluble silicates, after which they were eliminated by filtration. The nickel was then precipitated as hydroxide with sodium hydroxide solution in a large platinum dish, and weighed as oxide. The nickel content of the various catalysts prepared for this work was approximately 23 per cent.

In hydrogenating oils the concentration of the catalyst in per cent of nickel was calculated in the following manner: If the catalyst contains 23.44 per cent nickel then 4.27 grams of catalyst contains 1 gram of metallic nickel. In these experiments 100 grams of oil were used for hydrogenation. If 4.27 grams of catalyst containing 1 gram of metallic nickel were used to hydrogenate 100 grams of oil then the concentration of metallic nickel for this quantity of oil was considered to be 1 per cent. In all the experiments the concentration of the catalyst was calculated in this manner.

The catalyst was reduced in each case immediately before it was mixed with the oil. The procedure was as follows: The calculated quantity of catalyst was placed in a transparent quartz combustion tube and spread out in a long thin layer. Hydrogen gas, purified as previously stated, was passed through the tube, which was gradually heated in a combustion furnace to a temperature of about 300° (fig. 1). The exit end of the combustion tube contained a trap, *t*, which served as a receptacle for collecting the water given off during the reduction.

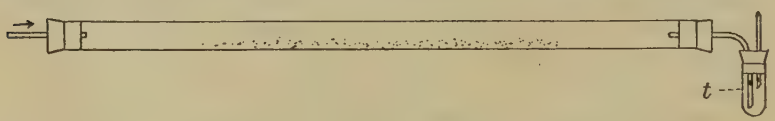


FIG. 1. Fused-quartz tube with water trap, used for preparing catalyst.

The reduction was continued for a period of about fifteen minutes, or until no more water was apparently given off. The current of hydrogen was allowed to continue flowing through the tube, which was now allowed to cool gradually to room temperature.

After reduction, the catalyst is oxidized readily when exposed to the air and consequently loses to a considerable extent its activity. In order to avoid exposing the catalyst to the air, a current of carbon dioxide gas, which was purified by passing

through silver nitrate solution and anhydrous calcium chloride, was conducted into the hydrogenating vessel above the surface of the oil contained in it. One end of the tube containing the reduced catalyst was now opened, inserted into the hydrogenation flask, and the catalyst allowed to drop quickly into the oil, after which the flow of carbon dioxide was discontinued. The tube through which the purified carbon dioxide was conducted was now removed, and the flask containing the oil and catalyst connected immediately to the stirring apparatus.

The hydrogenation flask was immersed in an oil bath, which was placed upon an electric heater. The flask was connected to a mercury gauge, *o* (fig. 2), which was used to indicate the slight pressure of gas (usually about 2 centimeters) in the apparatus. The oil bath was heated to a temperature of 180°.

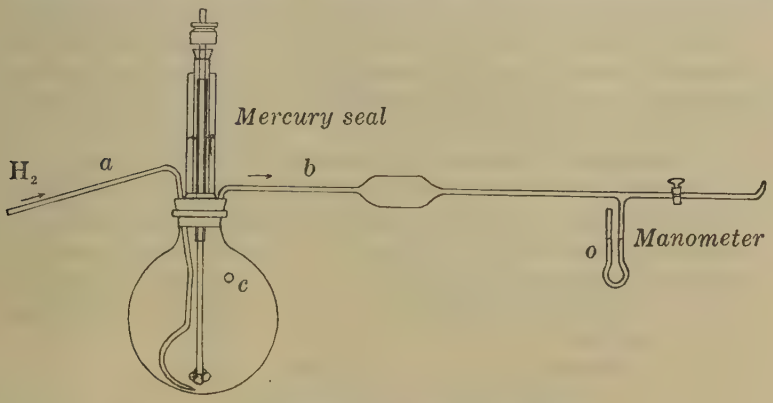


FIG. 2. Hydrogenation apparatus, showing details.

In hydrogenating an oil it is, of course, necessary to use a carefully constructed apparatus, which will allow no leakage of gas, and thus avoid explosions. The hydrogenation apparatus (fig. 2 and Plate 1) used in these experiments contained a mercury trap which allowed the mixture of oil and catalyst to be stirred during the hydrogenation. The hydrogen was admitted to the flask through the entrance tube *a*, and allowed to leave through the exit tube *b*. The hole *c*, which is about 1 centimeter in diameter, was bored into the side of the flask by means of a spear-shaped drill and enlarged with a round file.[7] In making the hole the drill was moistened with a solution of camphor dissolved in turpentine. The stopper, which was

[7] Scientific American Cyclopedia of Formulas (1918) 491.

placed very firmly in this side hole, was removed temporarily at intervals during the hydrogenation experiments, so that a pipette could be inserted into the opening and a sample of the mixture withdrawn without discontinuing the stirring or the flow of gas. The uniform sample of hydrogenated oil thus obtained was not contaminated by small quantities of previous samples; contamination occurs when the hydrogenated oil is siphoned out of the flask. In this method of hydrogenation the safety of manipulation depends upon the mercury trap, a larger diagram of which is shown in fig. 3. The stirring rod, operated by a small electric motor, passed through the tube *e*, which was inclosed in the mercury trap, *f*, *g*.

As it is somewhat difficult to filter the catalyst out of a small sample of oil which has been hardened, the samples of hydrogenated oil were treated with boiling ether. The ethereal solution containing the extracted fat was then filtered and the ether distilled off in a partial vacuum at 40°. The samples thus obtained were analyzed by determining the iodine value (Hübl) and the melting point.

In experiments requiring an unusual length of time, as in the preparation of twenty-hour samples of hydrogenated oil, it was not convenient to continue the hydrogenation and collect all the samples in one day. Therefore, the samples were collected at convenient intervals of time, after which the oil bath was removed from beneath the hydrogenation flask and the flow of gas discontinued until the following day.

In hydrogenating the oils, considerable difficulty was experienced in obtaining uniformly good results. In some experiments the catalyst worked excellently, while in others it was not so effective and, although the oil hardened, the iodine value was not greatly reduced. This was probably due to the fact that it was difficult to keep the atmosphere of the laboratory entirely free of obnoxious gases which poisoned the catalyst and decreased its activity. According to Ellis [8] mere traces of halogens or sulphur cause catalysts to lose their efficiency.

When working with a freshly prepared catalyst it is a good plan to make a preliminary test to ascertain its efficiency before proceeding with hydrogenation experiments. This may be done by using about 2 per cent nickel and hydrogenating an oil, like pili nut or cotton seed, which solidifies readily under favorable conditions and becomes a soft white solid in about an hour.

[8] Ellis, C. E., The Hydrogenation of Oils (1919) 113.

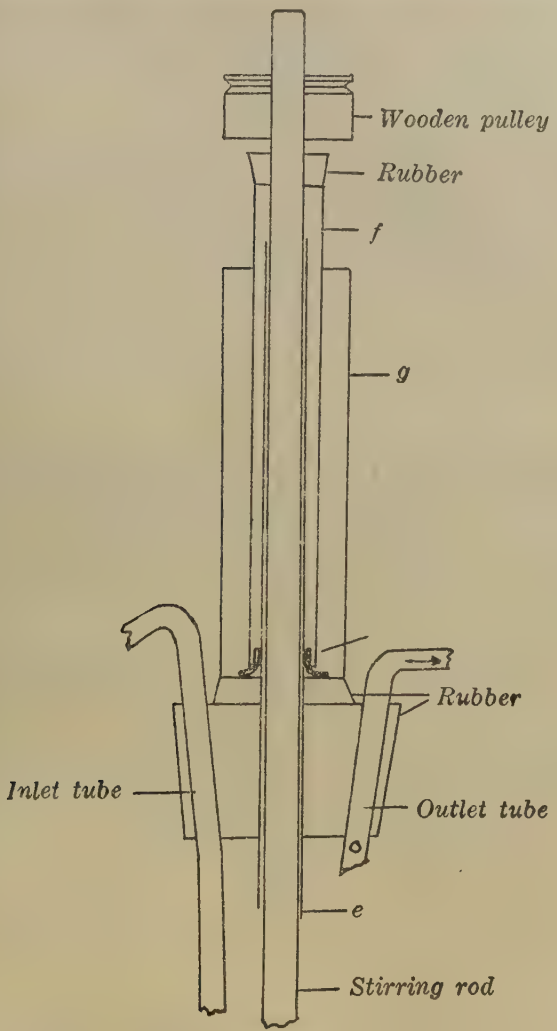


FIG. 3. Mercury trap of the hydrogenation apparatus, showing details.

SAMPLES

The samples of oils used in this investigation were obtained from fresh seeds. The seeds were shelled and the kernels ground into a meal, which was then placed in a small press and the oil separated from the oil cake. The oil was then filtered and preserved in glass-stoppered bottles, which were paraffined and kept in a dark closet until ready for use. The iodine value

of each of the oils, before hydrogenation, was determined on the fresh samples that were prepared and is recorded in the tables showing the results of hydrogenation.

RESULTS

Both drying and nondrying Philippine oils were used in this investigation. A review of the literature on these oils, giving data as to constants, general properties, and uses, as well as the growth and distribution of the Philippine trees from which they are obtained, is given by West and Brown.[9]

In these experiments the concentration of catalyst and time of hydrogenation were varied and, consequently, the results obtained show the effects of hydrogenation under various conditions.

LUMBANG OIL

Lumbang (candle-nut) oil is obtained from the nuts of *Aleurites moluccana,* which is a large tree reaching a diameter of 80 to 160 centimeters. It is used in the manufacture of paints and varnishes. The constants and the general properties of lumbang oil have been determined by various investigators.[10]

The results show that lumbang is a drying oil characterized by high iodine and saponification values.

The composition[11] of lumbang oil has been determined by means of the lead-salt-ether and bromo-derivative methods. The results (Table 1) show that lumbang oil contains the glycerides of linolenic, linolic, and oleic acids and therefore has a composition quite similar to linseed oil.

TABLE 1.—*Composition of lumbang oil.*

Constituent.	Per cent.
Linolenic glyceride	6.56
Linolic glyceride	33.48
Oleic glyceride	56.98
Glycerides of solid acids	2.85
Total	99.87

[9] West, A. P., and Brown, W. H., Bull. Philip. Bureau Forestry 20 (1920).

[10] Richmond, G. F., and Rosario, M. V. del, Philip. Journ. Sci. § A 2 (1917) 439; Wilcox E. V., and Thompson, A. R., Press Bull. Hawaii Agr. Exp. Station 39 (1913); Brill, H. C., and Agcaoili, F., Philip. Journ. Sci. § A 10 (1915) 111; Aguilar, R. H., Philip. Journ. Sci. § A 12 (1917) 235 and 14 (1919) 275; West, A. P., and Brown, W. H., Bull. Philip. Bureau Forestry 20 (1920) 121; West, A. P., and Montes, Z., Philip. Journ. Sci. 18 (1921) 619.

[11] West, A. P., and Montes, Z., Philip. Journ. Sci. 18 (1921) 630.

West and Smith made various commercial products, such as paints, varnishes, putties, soaps, and printing inks, from lumbang and linseed oils under identical conditions.[12] Their results show that as a drying oil lumbang appears to be just as good as linseed, and either oil can be used as an efficient substitute for the other.

TABLE 2.—*Hydrogenation of lumbang oil.*[a]

Time of hydrogenation.	Nickel.					
	0.5 per cent.		1 per cent.		3 per cent.	
	Iodine value, Hübl.	Melting point.	Iodine value, Hübl.	Melting point.	Iodine value, Hübl.	Melting point.
Hours.		°C.		°C.		°C.
1	135.0	[b]	121.9	[b]	120.25	[b]
3	96.16	[c]	91.03	[d]	89.45	[e]
5	80.70	[f]	77.60	[f]	75.05	[f]
7	57.03	42–63	51.45	42–60	58.25	49–56.5
10	38.94	52–63.5	23.64	60–67	32.32	58–64.5
15	27.93	60–70	8.85	60–68.5	7.55	67–69.5
20			1.65	66–70	1.08	67.5–71.5

[a] The iodine value of lumbang oil before hydrogenation was 153.2.
[b] Liquid.
[c] Ten per cent solid.
[d] Fifteen per cent solid.
[e] Thirty per cent solid.
[f] Soft solid.

When oils are subjected to catalytic hydrogenation the unsaturated glycerides (linolenic, linolic, and oleic) absorb hydrogen and are gradually converted to stearin on complete reduction, while incomplete reduction leads to the formation of mixed glycerides which are partly unsaturated as shown by the iodine value of the reaction product.

The results of hydrogenating lumbang oil for various intervals of time with different concentrations of catalyst are given in Table 2. As shown by the data, lumbang oil is easily hydrogenated when reduced with an effective catalyst. For each period of hydrogenation, increase in the concentration of catalyst from 0.5 to 1 per cent of nickel gave a decrease in the iodine value and an increase in the melting point. Similar results were expected for an increase from 1 to 3 per cent in the concentration of the catalyst. Hydrogenation with 3 per cent nickel

[12] Bull. Philip. Bureau Forestry 24. In press.

gave, however, about the same results as with 1 per cent. Possibly this was due to the fact that the catalyst was not working so effectively in this particular reduction.

Lumbang oil consists almost entirely of a mixture of linolenic, linolic, and oleic glycerides. When lumbang oil is completely hydrogenated the reduction product should, theoretically, have no iodine value, and the melting point should be approximately 71.6°, which is the melting point of pure stearin. With a catalyst containing 3 per cent nickel, hydrogenation for twenty hours at practically atmospheric pressure gave a sample having a melting point of 67.5° to 71.5° and an iodine value of only 1.08. This result would seem to indicate that the hardened lumbang oil, which had the appearance of a hard, white solid, was nearly pure stearin.

The results obtained experimentally agree fairly well with the results estimated from the composition of the oil, and indicate that lumbang contains no considerable quantity of saturated glycerides of low melting point. The result of complete hydrogenation serves, therefore, as a kind of check on the composition of the oil as determined by analysis.

PILI NUT

Pili-nut oil is obtained from the nuts of *Canarium ovatum*, which is a tree reaching a height of about 20 meters and a diameter of 40 centimeters. This species is very abundant in southern Luzon. The fruits are 6 to 7 centimeters in length and consist of hard, thick-shelled, triangular nuts surrounded by a small amount of pulp. Pili nuts are rich in oil and when roasted have a delicious flavor. They are used in making confections and by many are considered superior to almonds. Pili-nut oil is light yellow, has an agreeable odor and taste, and is suitable for culinary purposes.

The composition [13] of pili-nut oil has been determined by means of the lead-ether and bromo-derivative methods. Table 3 shows that pili-nut oil consists largely of the glycerides of oleic and palmitic acids and contains also a small percentage of stearic glyceride.

[12] Composition determined by A. P. West and S. Balce, antea 269.

TABLE 3.—*Composition of pili-nut oil.*

Constituent.	Per cent.
Oleic glyceride	59.6
Palmitic glyceride	38.2
Stearic glyceride	1.8
Unsaponifiable matter	0.2
Total	99.8

TABLE 4.—*Hydrogenation of pili-nut oil.*[a]

Time of hydrogenation.	Nickel.					
	0.5 per cent.		1 per cent.		3 per cent.	
	Iodine value, Hübl.	Melting point.	Iodine value, Hübl.	Melting point.	Iodine value, Hübl.	Melting point.
Hours.		°C.		°C.		°C.
1	58.87	(b)	51.53	(b)	51.43	(b)
3	55.72	(c)	48.08	39–47	40.64	44–46
5	50.42	37–42	38.19	43–53	26.90	49–61
7	48.90	42–45	27.23	47–58	10.46	58–62
10	41.69	42–49	23.99	50–60	3.91	62–65
15	40.12	46–50	13.24	59–62	0.96	66–66.80
20	34.20	46–57	9.69	61–63		

[a] The iodine value of pili-nut oil before hydrogenation was 60.5.
[b] Liquid.
[c] Soft solid.

The results of hydrogenating pili-nut oil for various intervals of time with different concentrations of catalyst are given in Table 4. In these experiments the catalyst was very effective and the oil absorbed hydrogen readily.

The results show that, with each concentration of catalyst, continued hydrogenation gave a gradual decrease in the iodine value of the oil and an increase in the melting point.

For each interval of hydrogenation, increase in the concentration of nickel catalyst gave an increase in the melting point of the oil and a very decided decrease in the iodine value. Hydrogenation for ten hours gave with 0.5 per cent nickel an iodine value of 41.69; with 1 per cent, 23.99; and with 3 per cent, 3.91. Hydrogenation for fifteen hours with 3 per cent nickel gave a sample having an iodine value of only 0.96 and a melting point of 66° to 66.8°. In appearance the sample was a hard white solid. Since oleic glyceride when reduced

yields stearin (melting point, 71.6°) it would seem that the melting point of this sample should have been somewhat higher. The rather low value obtained is probably due to the fact that in determining the melting point the stearin tends to dissolve in the palmitin (melting point, 63° to 65.5°), which has a lower melting point. A test experiment was performed by mixing stearin with palmitin in the same proportions as they are present in hydrogenated pili-nut oil. The melting point of the mixture was found to vary from 68° to 69°. These values are slightly higher than the results obtained with hydrogenated pili-nut oil but, as Lewkowitsch [14] has pointed out, even pure glycerides show irregularities in their melting points which are not usually given by definite chemical compounds. The results of these experiments indicate that pili-nut oil contains no saturated glycerides of low melting point and, in general, agrees in composition with the oil that showed the saturated glycerides to consist mostly of palmitin.

TABLE 5.—*Hydrogenation of pili-nut and lumbang oils.*[a]

Hydrogenation.	Nickel, 1 per cent. Iodine value, Hübl.			
	Pili-nut oil.		Lumbang oil.	
	Catalyst I.	Catalyst G.	Catalyst I.	Catalyst G.
Hours.				
1	51.53	53.12	121.9	135.55
3	48.08	44.9	91.03	118.25
5	38.19	37.0	77.6	101.05
7	27.23	27.37	51.45	92.7
10	23.99	19.21	23.64	83.6
15	13.24	----------	8.85	60.4
20	9.68	----------	1.65	32.3

[a] Before hydrogenation the iodine value of pili-nut oil was 60.5, and of lumbang, 153.2.

The results of hydrogenating pili-nut and lumbang oils with different catalysts, each of which had a concentration of 1 per cent nickel, are given in Table 5. These catalysts were made under identical conditions and were expected to give the same results. Both catalysts gave approximately the same results with pili-nut oil. With lumbang oil, however, catalyst I was considerably more effective than catalyst G. The data given for catalyst G show how the activity of the catalyst may some-

[14] Lewkowitsch, J. Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 321.

times be retarded due, perhaps, to slight contaminating influences.

COCONUT OIL

Elsdon [15] determined the approximate composition of the mixed fatty acids of coconut oil by the method of alcoholysis. The results are recorded in Table 6.

TABLE 6.—*Approximate composition of the mixed fatty acids of coconut oil.*

Acid.	Per cent.
Caproic	2
Caprylic	9
Capric	10
Lauric	45
Myristic	20
Palmitic	7
Stearic	5
Oleic	2
Total	100

TABLE 7.—*Hydrogenation of coconut oil.*[a]

Time of hydrogenation.	Nickel, 3 per cent.	
	Iodine value, Hübl.	Melting point.
Hours.		°C.
1	7.38	(b)
3	3.70	30–37
5	1.71	32–39
7	1.14	32–40.5
10	0.71	32–41
15	0.35	32–41
20	0.00	32–42
25		32–43

[a] The iodine value of coconut oil before hydrogenation was 8.22. [b] Liquid.

Coconut oil hydrogenated with 3 per cent nickel is gradually decolorized and deodorized, but apparently does not harden very readily. Hydrogenation for fifteen hours gave a solidified sample having practically no iodine value and a melting point of 32° to 41° (Table 7). Coconut oil consists principally of the glycerol esters of lauric and myristic acids and contains also a number of other fats which are the glycerides of other fatty acids, such as caproic, caprylic, capric, and oleic (Table 6). Caproic glyceride is a liquid, while caprylic melts at 8.3°; caproic, at 31.1°; and lauric, at 45°. Although these glycerides are satu-

[15] Elsdon, G. D., Analyst 38 (1913) 8.

rated compounds they do not have high melting points, and probably for that reason coconut oil when hydrogenated is not hardened readily in the Tropics. Again the iodine value (8.22) of coconut oil is very low, which indicates that it contains only a small proportion of unsaturated glycerides and, consequently, the effect of hydrogenation is not so marked as in the case of other oils which have much higher iodine values.

PALOMARIA (BITAOG) OIL

Oil obtained from the seeds of *Calophyllum inophyllum* is known as bitaog, or palomaria de la playa. *Calophyllum inophyllum* is usually a medium-sized or large tree with a wide-spreading crown. It is distributed in the coast regions in various parts of the Philippines. The fruit of this species is about the size of a walnut. It has an outer fleshy part and contains a thin-shelled seed with a hard, oily kernel. The kernels yield palomaria (bitaog) oil, which is greenish yellow and has a bitter, pungent taste. According to Crevost,[16] palomaria oil contains 71.55 per cent of fatty oil and 28.45 per cent of resin. The resin is dark brown and melts at 30° to 35°. It is soluble in various organic solvents, has an iodine value of 125.2, and an acid value of 180.8.

Fenler [17] states that the fatty acids of palomaria oil consist largely of palmitic, stearic, and oleic acids.

TABLE 8.—*Hydrogenation of palomaria oil* [a]

Time of hydrogenation.	Nickel, 3 per cent.		Nickel, 5 per cent.	
	Iodine value, Hübl.	Melting point.	Iodine value, Hübl.	Melting point.
Hours.		°C.		°C.
1	83.6	[b]	81.2	[b]
3	71.65	[c]	68.35	[d]
5	67.0	[d]	57.75	37–43
10	62.3	43–50		

[a] The iodine value of palomaria oil before hydrogenation was 88.1.
[b] Liquid.
[c] Twenty per cent solid.
[d] Soft solid.

By continued hydrogenation of palomaria, the dark brown oil was gradually changed to a light yellow solid. This was the only oil used in this investigation which was not entirely de-

[16] Crevost, B., Bull. Econ. de L'Indochine, new series 8 (1906) 394.
[17] Fenler, G., Chem. Zeit. 29 (1905) 15.

colorized by hydrogenation. The data given in Table 8 show that, in hydrogenating for a definite period, increase in the percentage of nickel catalyst gave a decrease in the iodine value and an increase in the melting point. Although catalysts containing 3 and even 5 per cent nickel were employed, the oil was not reduced to a hard solid fat of high melting point. Probably this was due to the fact that the hydrogenation was not continued for a sufficient length of time and, moreover, the oil contained about 28 per cent of resin which had a very high acid value. The acid value of the oil was determined before hydrogenation and found to be 22.04.

CATALYTIC HYDROGENATION

The catalytic hydrogenation process is coming into more-general use in synthetic organic chemistry where results of reduction reactions are desired. The review of the literature given by Maxted [18] and by Rideal and Taylor [19] shows the numerous applications of this process, and Lewkowitsh [20] recommends it for the preparation of unsaturated acids for identification. The old method of reducing compounds by treating them with a metal and an acid, or of dissolving them in some solvent such as alcoholic hydrochloric acid and adding a metal like zinc, is not entirely satisfactory because it is somewhat difficult to control the reaction and obtain the desired degree of reduction. Catalytic hydrogenation can be controlled to a certain extent, and in many reactions excellent results are obtained.

The hydrogenation apparatus and general laboratory procedure used in this investigation of Philippine oils gave very good results. The apparatus is easy to manipulate, and samples of the hydrogenated product having the desired degree of saturation are easily obtained. Probably this method would prove useful for certain reductions in synthetic organic chemistry where exact control of hydrogen absorption is required.

SUMMARY

A convenient and simple laboratory apparatus for the catalytic hydrogenation of oils has been described. With this appa-

[18] Maxted, E. B., Catalytic Hydrogenation and Reduction (1919).

[19] Rideal, E. K., and Taylor, H. S., Catalysis in Theory and Practice (1919).

[20] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 589.

ratus the mixture of oil and catalyst can be stirred thoroughly, and uncontaminated samples of hydrogenated oil can be taken conveniently when the desired degree of absorption is attained.

The preparation of a nickel catalyst and the general procedure for laboratory hydrogenation experiments with oils have been described in detail.

The following Philippine oils were solidified: Lumbang, pili nut, coconut, and palomaria. The data obtained show that the apparatus employed and the experimental procedure followed gave excellent results under favorable conditions.

Lumbang oil was reduced to a hard solid which had an iodine value of 1.08 and a melting point of 67.5° to 71.5°. These results are in agreement with the fact that lumbang oil is composed almost entirely of linolenic, linolic, and oleic glycerides, all of which when completely reduced should, theoretically, be converted into stearin (melting point, 71.5°).

Pili-nut oil when hardened had an iodine value of 0.76 and a melting point of 66° to 66.8°. The results indicated that pili-nut oil, like lumbang, has no saturated glycerides of low melting point.

Coconut oil when completely hydrogenated had a melting point of 32° to 43° and no iodine value. The low melting point of the hardened oil is apparently due to the fact that coconut oil contains saturated glycerides which have low melting points.

Palomaria oil when hardened was not reduced to a hard solid of high melting point and low iodine value. Probably this was due to the high acidity of the oil.

Oils hydrogenated with catalysts containing different percentages of nickel showed that, for a definite period of absorption, an increase in the concentration of nickel gave a decrease in the iodine value and an increase in the melting point.

This method of catalytic hydrogenation may prove useful, not only for ascertaining readily the comparative absorption of hydrogen by different kinds of oils, but also for making certain reductions in synthetic organic chemistry.

We wish to express our thanks and appreciation to Mr. Arthur F. Fischer, director of the Philippine Bureau of Forestry, for the material used in this investigation and the assistance he has kindly given.

ILLUSTRATIONS

PLATE 1

FIG. 1. Hydrogenation apparatus, side view.
2. Hydrogenation apparatus, front view.

TEXT FIGURES

FIG. 1. Fused-quartz tube with water trap, used for preparing catalyst.
2. Hydrogenation apparatus, showing details.
3. Mercury trap of the hydrogenation apparatus, showing details.

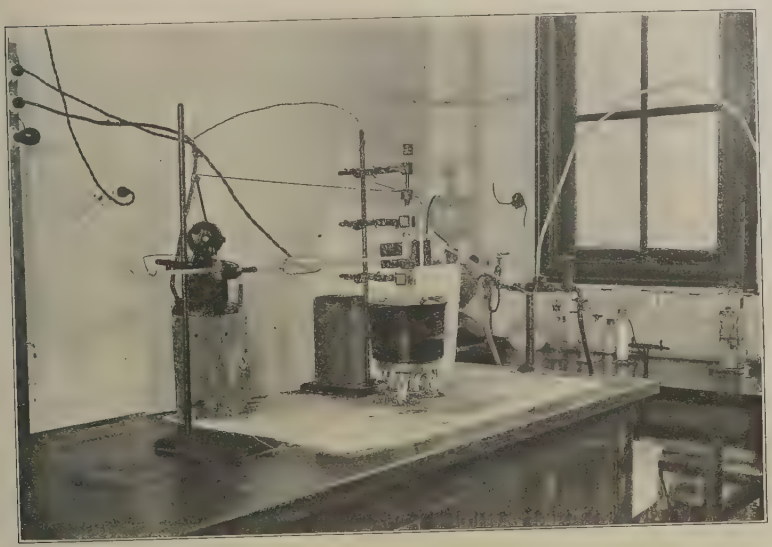


Fig. 1. Side view.

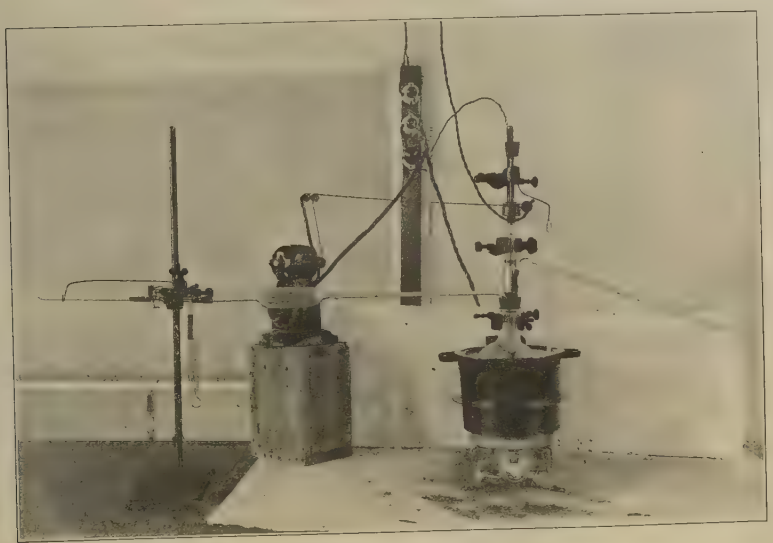


Fig. 2. Front view.

PLATE 1. HYDROGENATION APPARATUS.

SOME NEW MALAYAN CARABIDÆ, ESPECIALLY PHILIPPINE

By K. M. Heller

Zoölogical Museum, Dresden, Germany

ONE PLATE

The following descriptions of new species are based for the most part upon material collected by Prof. C. Fuller Baker in various localities in the Philippine Archipelago and in Sandakan, northeastern Borneo; upon the material kindly forward to me by Mr. W. Schultze, of Manila, collected by himself, Mr. R. C. McGregor, and Mr. E. H. Taylor; and upon the material in the Dresden Museum, collected by the late Dr. A. Schadenberg.

The species here treated belong to the following tribes:

HELLUONINI

Macrochilus ruficollis sp. nov.
Macrochilus tripustulatus F.

SCARITINI

Thlibops integricollis sp. nov.
Thlibops abbreviatus sp. nov.
Thlibops puncticollis Gestro.
Thlibops crenata Chaudoir.
Thlibops longicollis Putz.
Thlibops dohrni Chaudoir.
Thlibops minor Heller.
Thlibops glabriventris Heller.
Thlibops omega Heller.
Thlibops intermedius Heller.
Thlibops paviei Lesne.
Scarites longiusculus Chaudoir.

PTEROSTICHINI

Anchomenus (*Agonum*) *nigrosericans* sp. nov.

TRIGONOTOMINI

Triplogenius (*Lesticus*) *busuangae* sp. nov.
Triplogenius (*Lesticus*) *prasinus* Tschitsch.
Triplogenius (*Lesticus*) *insignis philippinensis* Kuntzen.

TRIGONOTOMINI—Continued

Triplogenius (*Lesticus*) *macgregori* Kuntzen.
Triplogenius (*Lesticus*) *cupreatus* sp. nov.
Trigonotoma luzonica Chaud.
Trigonotoma leotaudi Tschitsch.
Trigonotoma palawanica Tschitsch.

CHLAENIINI

Euschizomerus rufipes var.? *pilosulus* var. nov.
Chlaenius cuspidatus sp. nov.

MASOREINI

Anaulacus sericeipennis philippinensis subsp. nov.

TETRAGONODERINI

Cyclosomus philippinus sp. nov.

DRYPTINI

Desera (*Dendrocellus*) *schultzei* sp. nov.
Desera geniculata Klug.
Desera unidentata MacLeay.
Desera parallela Chaud.
Desera smaragdina Chaud.
Desera ternatensis Chaud.

DRYPTINI—Continued

Desera longicollis Dej.
Desera gestroi H. W. Bates.
Desera aeneipes Wied.
Desera discolor Schm. Göb.

LEBIINI

Physodera eburata sp. nov.
Physodera bifenestrata sp. nov.

LEBIINI—Continued

Physodera dejeani Eschsch.
Physodera eschscholtzi Parry.
Physodera parvicollis v. de Poll.
Physodera cyanipennis v. de Poll.
Physodera amplicollis v. de Poll.

HELLUONINI

Macrochilus ruficollis sp. nov. Plate 1, fig. 1.

Macrochilus tripustulatus F. affinis sed minor, piceus, macula frontali thoraceque sanguineis, oris partibus, antennis, pedibus maculisque tribus in elytris, una utrinque longitudinali ovata, ante medium, altera apicali communi, suturali, testaceis; epistomo glabro, punctis setuligeris solum quatuor, fronte per longitudinem capite reliquo multo parcius punctato; prothorace linea mediana paulo latiore (5.4: 6), ad angulos posticos oblique truncato, lateribus ante truncaturam subsinuatis dein obtusangulatis, disco utrinque area longitudinali parcius, impressione in angulis posticis crebre punctato, sulco mediano distincto; elytris macula anteriore inter striam secundam et nonam (submarginalem majus punctatem) sita, posteriore communi striam quartam tangente, margine anteriore bilobato. Long. 9.5, lat. 2.8 mm.

LUZON, Laguna Province, Los Baños (*Baker*).

This species, like *M. tripustulatus* F., exhibits in the anterior half of each elytron a yellowish but larger spot which extends from the second to the marginal stria and an apical spot on the suture, laterally touching the fifth stria and the apical margin. The prothorax is red, proportionately longer than in any other species of the genus, and distinctly more sparsely punctate on each side of the disk than in the other parts; the elytra are nearly twice as long as broad (5.5: 3), the striæ comparatively more distinctly punctate than in *M. tripustulatus* F. *Macrochilus tripustulatus* F. occurs in the Philippines.[1]

SCARITINI

Thlibops integricollis sp. nov.

Thlibops omega m. paullo longior, fronte rugosa, tuberculo, subconico, mediano, instructa; prothorace utrinque impressione, basali, nulla; elytris pro proportione longioribus, maxima latitudine in secundo triente, striis tribus subsuturalibus obsoletis,

[1] Deutsche Ent. Zeitschr. (1916) 269.

solum ad basin observandis ac in parte apicali manifestis, hic spatiis costatis; metasterno lateribus episternisque haud punctatis; sternito abdominali tertio quartoque secundum marginem basalem sat late, primo secundoque lateribus vix punctulatis. Long. 17.5 ad 20.5, lat. 4.5 ad 5 mm.

LUZON, Benguet Province, Baguio: Zambales Province, Iba (*W. Schultze*).

This species can be readily recognized by the rugulose front which bears a conical tubercle in the middle, by the lack of a basal impression on each side of prothorax, and by the obsolete three interior elytral striæ which are distinct only at the base and toward the apex. The specimen from Zambales Province is smaller and shows an obsolete frontal tubercle but agrees in other respects with a smaller specimen of *T. integricollis*.

Thlibops abbreviatus sp. nov.

Thlibops intermedio m. similis, sed fronte tuberculo conico armata; prothorace linea mediana distinctius remote seriatopunctata; elytris spatiis alternatis latioribus ac convexioribus apice abbreviatis et hic haud confluentibus, spatio septimo parte apicali inflato ac ordine suturam attingente; metasterno lateribus episternisque perparce, abdomen fere toto punctato, sternito abdominali praeterea transverse rugoso. Long. 18.5, lat. 3.3 mm.

LUZON, Rizal Province, Montalban (*W. Schultze*).

Differs from all the other Philippine species by the shorter intervals of elytra, which are alternately much broader and more convex and not confluent at the apex. The metasternum and metaepisterna are sparsely rugose, the last three ventral abdominal segments throughout distinctly punctate, and the anal segment is transversely rugose.

The known species of the genus *Thlibops* Putz. (*T. longicollis* Putz., *T. puncticollis* Gestro, and *T. paviei* Lesne I know only from the descriptions) can be distinguished by the following characters:

1 (17). Prothorax with a distinct sulciform basal impression on each side.
2 (7). All striæ of elytra entirely punctate-striate.
3 (4). Sides of prothorax with sparse unequal punctures; length, 11 millimeters. Burma..... T. puncticollis Gestro.[3]
4 (3). Sides of prothorax without punctures.
5 (6). Second and fourth intervals of elytra without punctures; length, 15 millimeters. Cochin-China ..... T. crenata Chaudoir.
6 (5). Second and fourth intervals of elytra with four or five remote punctures; length, 9 millimeters. Gabun... T. longicollis Putz.

[3] Ann. Mus. Civ. Genova 18 (1822) 302.

7 (2). Striæ of elytra not, or at most the four interior striæ toward apex, punctate-striate.
8 (9). Alternate intervals (3, 5, 7) of elytra with four or five remote punctures; length, 21 millimeters. Java.... **T. dohrni Chaudoir.**
9 (8). All intervals without punctures.
10 (13). Striæ of elytra punctate-striate toward apex.
11 (12). Abdomen distinctly punctate along the middle; length, 12 millimeters. Luzon ..... **T. minor Heller.**[3]
12 (11). Abdomen broadly smooth along the middle; length, 13.5 millimeters. Luzon..... **T. glabriventris Heller.**[4]
13 (10). Striæ of elytra entirely impunctate.
14 (17). Intervals of elytra confluent toward apex.
15 (16). Second interval of elytra (between striæ 1 and 2) in the basal half not more convex than the others and not much broader than the third; length, 21 millimeters. Luzon..... **T. omega Heller.**[5]
16 (15). Second interval of elytra entirely convex and twice as broad as third; length, 20 millimeters. Luzon.. **T. intermedius Heller.**[6]
17 (14). Intervals of elytra abbreviated and not confluent toward apex, exposing a triangular, even apical, space; length, 19 millimeters. Luzon..... **T. abbreviatus sp. nov.**
18 (1). Prothorax without or with only a feebly indicated basal impression.
19 (20). Striæ of elytra indistinctly, the abdomen not, punctate; length, 12.5 millimeters. Siam..... **T. paviei Lesne.**[7]
20 (19). Striæ of elytra impunctate, abdomen distinctly punctate on the sides; length, 16.5 to 20 millimeters. Luzon.
T. integricollis sp. nov.

Scarites longiusculus Chaudoir, described from the Philippines without exact locality, occurs at Mansalay, Mindoro, where it was collected by E. H. Taylor (Bureau of Science collection).

PTEROSTICHINI

Anchomenus (Agonum[8]) nigrosericans sp. nov.

A. quadripunctato Dej. (spec. *palaearctica*) similis, sed minus elongatus, capite plus transverso, clipeo minus transverso, polito (in *quadripunctato* subtilissime coriario), prothorace paulo angustiore, minus transverso, angulis posticis plus indicatis; elytris brevioribus, notabiliter albo-sericeo micantibus, lateribus subrotundatis, striis subtilissimis, apicem versus manifeste im-

[3] Deutsche Ent. Zeitschr. (1916) 275.
[4] Deutsche Ent. Zeitschr. (1916) 276.
[5] Abh. Mus. Dresden No. 7 (1899) 3.
[6] Philip. Journ. Sci. 19 (1921) 530.
[7] Bull. Mus. d'Hist. Nat. Paris (1896) 239.
[8] Cf. Semenow, Apercu des genres palaearctic de la Tribu des Anchomenides, Bull. Nat. Moscow 2 (1888) 686.

pressis, stria quinta sextacum in secundo triente conjunctis, spatio secundo marginalique, ut in *quadripunctato, foveolatis,* foveolis duabus postmedianis in spatio secundo alteri minus approximatis, tarsis utrinque haud sulcatis. Long. 5, lat. 2 mm.

LUZON, Benguet Subprovince, Mount Santo Tomas (*W. Schultze*).

Very similar to the European *A. quadripunctatum* Dej. but smaller; the elytra shorter, more rounded on the sides, and strikingly silky white; the fifth and sixth striæ joined in the second third of their length; clypeus smooth (not finely coriaceous as in *quadripunctatum*); and sides of prothorax before the more-distinct posterior angles a little more perceptibly emarginate.

TRIGONOTOMINI

Triplogenius (Lesticus) busuangae sp. nov. ♀.

L. insigni Gestro[9] magnitudine fere aequali, sed elytris plus ovatis ac convexioribus, spatiis multo (fere ut in *assamico* Kuntzen) convexioribus, unicolor violaceus; antennis nigris, articulo tertio primo distincte longiore; fronte utrinque impressione longitudinali, foveolato-dilatata ac crebre punctata, extrinsecus toro, oblique strigoso determinata; prothorace transverso, lateribus postrorsum plus quam antrorsum rotundato-attenuatis, maxima latitudine ante medium, usque ad basin elevato-marginatis, angulis posticis obtusangulatis, area intermarginem lateralem et impressionem basalem (ut impressione) disperse subtiliterque punctata; elytris lateribus rotundatis, stria scutellari brevissima, sulco marginali usque ad striam primam percurrente, ad humeros angulato, crenato-striatis, spatiis convexis, spatio octavo, carinato, reliquis angustiore; episternis disperse fortiterque prothoracis postrorsum parcius punctatis sternito abdominali secundo post coxas seria transversae punctis sex formata, sternitis tres ultimis secundum marginem basalem sulco profundo, crenato-punctato. Long. 25, lat. 9 mm.

BUSUANGA (*Alexander Schadenberg*).

Triplogenius (Lesticus) cupreatus sp. nov.

T. mac-gregori Kuntzen affinis, sed supra unicolor cupreus, prothorace vix perspicue transversim undulato-rugoso, utrinque impressione basali levi, elytris subtiliter punctato-striatis, stria secunda in medio et in secundo triente, stria tertia in quinta parte

[9] Ann. Mus. Civ. Genova 18 (1883) 310.

basali, puncto impressis; sternito abdominali primo secundoque irregulariter transverse punctatis, meso-episternis solum in dimidia parte anteriore punctatis; tarsis articulo primo extrinsecus haud sulcato. Long. 22, lat. 9 mm.

LUZON (*Schadenberg*), Laguna Province, Mount Maquiling (*Baker*). For particulars see the following key:

Synopsis of the Philippine Trigonotomini.[10]

1 (12). Third antennal joint as long as or longer than first, antennæ not geniculate; labrum and epistomum truncate, hardly sinuate.

2 (3). Lateral margin of metasternal episternum longer than its front margin; posterior angles of prothorax usually very obtuse (no Philippine species known)..... **Triplogenius Chaud. s. str.**

3 (2). Lateral margin of metasternal episternum not longer than its front margin; posterior angles of prothorax sharply rectangular. **Triplogenius subg. Lesticus.**

4 (7). Dorsal intervals of elytra convex.

5 (6). Head and prothorax metallic green; elytra greenish black, nearly parallel sided; subscutellar stripe three to four times the length of scutellum; length, 25.5 millimeters. **T. (L.) prasinus Tschitsch.**

6 (5). Head and prothorax like the ovate elytra uniform violaceous; subscutellar stripe hardly more than twice the length of scutellum; basal impressions of prothorax finely punctate; length, 25 millimeters..... **T. (L.) busuangae sp. nov.**

7 (4). Dorsal intervals of elytra flat.

8 (9). Upper side violaceous or bluish green; upper side of first posterior tarsal joint outwardly sulcate; subscutellar stripe distinct, confluent with the first stria; basal furrow of elytra consisting only of the short incurvate basal part of the lateral furrow which does not reach fifth stria; length, 23.5 to 24 millimeters. **T. (L.) insignis philippinicus Kuntzen.**

9 (8). Upper side cupreous.

10 (11). Lateral margin of elytra concolorous, prothorax sometimes greenish; abdomen smooth, intermediate episterna nearly entirely punctate, posterior episterna entirely so; length, 17 millimeters. **T. (L.) mac-gregori Kuntzen.**

11 (10). Lateral margin like prothorax and the remaining upper side uniform cupreous; first and second ventral segments with irregular transverse rows of punctures; intermediate episterna punctate, in the anterior half only; subscutellar stripe very indistinct; first joint of posterior tarsi without a lateral furrow; length, 20 to 22 millimeters..... **T. (L.) cupreatus sp. nov.**

12 (1). Third antennal joint much shorter than first, antennæ geniculate; labrum and epistomum strongly sinuate..... **Trigonotoma Dej.**

[10] In the Catalogue of Philippine Coleoptera, Manila (1915) 13, the author confuses the tribe of Trigonomini (not Trigonominæ) with Pterostichini; these are both tribes of the family Harpalidæ.

13 (14). Labial palpi large triangular; basal impression on each side of prothorax smooth, only along its lateral margin with a few punctures, limited internally by a short and feeble furrow; sides of pro- and metasternum distinctly punctate; elytra cupreous; length, 20 millimeters..... **T. luzonica** Chaud.[11]

14 (13). Labial palpi elongate, moderately enlarged toward apex.

15 (16). Basal impression on each side of prothorax punctate internally and externally to the short furrow; elytra slightly purplish; all episterna feebly punctate; length, 14 millimeters.

T. leotaudi Tschitsch.

16 (15). Basal impression on each side of prothorax finely punctate; all episterna strongly punctate; elytra black, slightly shining bronzy; prothorax cupreous; length, 17.5 millimeters.

T. palawanica Tschitsch.

CHLAENIINI

Euschizomerus rufipes[12] var. ? **pilosulus** var. nov.

Specie typica robustior ac distinctius, sat longe, fulvo-pilosus; prothorace praeter punctationem subrugoso, lateribus medio minus dilatatis, elytris aeneis, fortius striato-punctatis, spatiis convexioribus. Long. 9, lat. 3.8 mm.

PANAY, Capiz Province, Culasi (*R. C. McGregor*).

Two specimens sent by Mr. Schultze, collected by Mr. McGregor, differ slightly from the typical specimen from Mount Maquiling in the larger size, and in the longer fulvous pubescence and stronger sculpture of the elytra, the intervals of which are also more convex and the color more bronzy. More-extensive material will perhaps make it necessary to separate this form as a subspecies or a species.

Chlaenius cuspidatus sp. nov.

Niger, opacus, capite viridi-aeneus, oris partibus, antennarum articulo primo pedibusque, tarsis infuscatis exceptis, testaceis, elytris signatura, communi, subapicali, cuspidata, lutea; capite creberrime subruguloso-punctato, sine impressionibus; prothorace, ut elytris, subtiliter crebreque granuloso, transverso, lateribus postrorsum plus quam antrorsum rotundato-attenuatis, margine antico subsinuato, angulis anticis obtusis, posticis obtusangulatis, sulco mediano distincto, intra angulis posticis

[11] Chaudoir, Ann. Soc. Ent. Belg. 11 (1888) 16, indicates 30 millimeters as the length of this species, probably in consequence of a misprint, otherwise he would have mentioned the extraordinary size. A specimen collected by Prof. C. Fuller Baker on Mount Maquiling (*13977*) agrees sufficiently with the description of *T. luzonica* Chaud. except that its length is 20 millimeters.

[12] The species is described in Philip. Journ. Sci. 19 (1921) 526.

impressione longitudinali; elytris sulco basi-marginali ad humeros haud angulato, subtilissime pubescentibus, signatura lutea, suturali, e lineolis in sutura, spatio primo secundoque dispositis formata. Long. 7, lat. 3 mm.

LUZON, Laguna Province, Los Baños (*14281*). MINDANAO, Davao Province, Davao (*Baker*).

This species resembles in sculptural characters the European *C. holosericeus* F. but is of much smaller size; the head metallic green, first joint of antennæ, mouth parts, and legs, except the infuscate tarsi, fulvous; an arrowhead-shaped subapical figure on the suture luteous. The prosternum is not marginate; third joint of antennæ longer than the following ones; labrum emarginate, testaceous.

MASOREINI

Anaulacus sericeipennis[13] **philippinensis subsp. nov.** Plate 1, fig. 2.

Differt a specie typica; elytris macula lutea, humerali, margine interno sutura parallelo, macula subapicali extus in margine laterali usque ad suturae apicem producta, margine laterali reliquo usque ad basin nigro. Long. 6, lat. 3.2 mm.

MINDANAO, Lanao Province, Iligan (*Baker*).

Like *fasciatus* Schm. Göb., I take *philippinensis* only for a subspecies of *sericeipennis* MacLeay, the chief difference lying in the pattern of the elytra as shown in the illustration.

TETRAGONODERINI

Cyclosomus philippinus sp. nov. ♀. Plate 1, fig. 3.

Cyclosomo flexuoso F. affinis, sed minor, lateribus plus rotundatis, elytris fascia submediana lata, nigra, foris abrupte attenuata ornatus, rufo-piceus, labro abdomine apicem versus, prothorace lateribus vitta marginali, lata, rufo-testaceis, palpis, antennis, pedibus elytrisque testaceis, his sutura tota, spatiis 1.-4. basi, spatiis 1.-3. praeterea in secundo treinte, 4.-6. in parte mediano nigricantibus, fasciam communem usque ad striam septimam, intra striam tertiam fere usque ad elytrorum apicem extensam, formantibus; striis fortius impressis, exterioribus (ab stria sexta) distincte seriato-punctatis. Long. 7.5, lat. 4.6 mm.

LUZON, Laguna Province, Los Baños (*Baker*).

Differs from *C. flexuosus* F.[14] in its smaller size, in the three more-convex interior intervals, the finely but distinctly punctate

[13] Cf. Chaudoir, Bull. Soc. Nat. Moscow II 51 (1876) 23.

[14] Cf. Dupuis, Revue Zoologique Africaine. Bruxelles 1 (1912) 384; and Chaudoir, Bull. Soc. Moscow II 51 (1876) 29.

fifth exterior stria, and the differently shaped blackish design of the elytra which is best shown by the figure (Plate 1, fig. 3). In *C. flexuosus* F. the design consists only of a narrow interrupted band representing the remaining posterior border of the reduced band of *C. philippinus*.

DRYPTINI

Desera[15] **(Dendrocellus) schultzei sp. nov.**

Desera gestroi Bates[16] affinis, capite prothoraceque nigro-cyaneis, oris partibus antennisque, his articulo primo dimidiato, nigro, excepto, ferrugineis; elytris nigris, ut capite prothoraceque subtiliter ochraceo-pubescentibus, femoribus tibiisque totis aterrimis, tarsis subrufescentibus; capite genis oculorum diametro dimidiato longitudine vix aequalibus; prothorace densissime ac transverse confluenter punctato, sulco mediano distincto; elytris vix olivascentibus, postrorsum ampliatis, apice angulo externo dentato, striis in dimidia parte basali fortiter, reliquis obsoletius punctatis, interstitiis basin versus convexioribus, fortiter crebreque punctatis. Long. 10.5, lat. elytror. 3.5 mm.

LUZON, Rizal Province, Montalban Gorge (*W. Schultze*).

Key to Indo-Australian species of Desera.

1 (12). Femora predominantly yellow or reddish yellow, sometimes black on apex.
2 (11). Tibiæ predominantly yellow or reddish yellow.
3 (6). Apical margin of elytra with a sharp edge on the outside. India Or., Java, Japan, etc..... **D. geniculata Klug.**
4 (5). Elytra slightly dilated toward apex. Java. **D. unidentata MacLeay.**
5 (4). Elytra parallel. Sumatra..... **D. parallela Chaud.**
6 (3). Apical margin of elytra obtuse angulate on outer edge.
7 (10). Prothorax with more-rounded sides than in *unidentata*.
8 (9). Color light green..... **D. smaragdina Chaud.**
9 (8). Color olivaceous..... **D. ternatensis Chaud.**
10 (7). Prothorax cylindrical with parallel sides in anterior third. Nepal, Calcutta, Burma..... **D. nepalensis Hope.**
11 (2). Tibiæ black, femora yellow, black on apex. India Or. **D. longicollis Dej.**
12 (1). Femora blackish, greenish or bluish black, at most the base yellowish.
13 (18). Tibiæ black.
14 (17). Elytra unicolorous.

[15] Leach, The Coleopterist's Manual, London, Part 2 (1838) 97 and 105, has priority over Schmidt Göbel's name *Dendrocellus*.

[16] Ann. Mus. Civ. Genova 32 (1892) 385.

15 (16). Femora piceous, red on the base; intervals of elytra a little punctate. Burma..... **D. gestroi H. W. Bates.**[17]

16 (15). Femora entirely deep black; intervals of elytra strongly and densely punctate. Luzon..... **D. schultzei sp nov.**

17 (14). Elytra deep cupreous on disk, broadly brassy green on base and apex. India..... **D. aeneipes Wied.**

18 (13). Tibiæ and tarsi yellowish, femora bluish black. Martaban, Burma. **D. discolor Schm. Göb.**

LEBIINI

Physodera eburata sp. nov. Plate 1, fig. 4.

Subviolaceo-nigra, elytris singulis inter striam tertiam et octavam callositate, discali, reniformi, eburnea; antennis articulis quatuor, basalibus, cyaneis, glabriusculis, reliquis pubescentibus, articulis 6.– 10. depressis, fere quadratis; fronte in dimidia parte anteriore utrinque longitudinaliter rugosa; prothorace in trienti exteriore deplanato, disco sulco mediano utrinque minute parceque, secundum marginem basalem fortiter inaequaliterque punctato, angulis posticis obtusangulatis; elytris latis, latitudine vix una tertiaque parte longioribus, in dimidia parte basali nitidis, in parte post callositatem opacis, striato-punctatis, striis post callositatem evanescentibus; corpore subter nigro-cyaneo, vix punctato. Long. 10.5, lat. 5 mm.

LUZON, Laguna Province, Los Baños (*Baker*).

For particulars see the key to the species.

Physodera bifenestrata sp. nov. Plate 1, figs. 5, 6.

Aterrima, elytris subviolascentibus, singulis plaga longitudinali, elliptica, permagna, lutea, intus stria prima approximata, extus stria extrema tangente, ornatis; antennis articulis, ab quinto ad undecimo, transversis; fronte in dimidia parte anteriore utrinque vix rugoso; prothorace area discali transversa, pulvinata, haud, margine postico disperse punctato, angulis posticis rectis; elytris totis nitidis, in parte ante maculam luteam striato-punctatis, solum stria subsuturali usque ad apicem continuata, in tertia parte apicali evanescenti; corpore subter aterrimo, nitido, vix punctato. Long. 9.5, lat. 4.5 mm.

BORNEO, Sandakan (*Baker*).

For particulars see the following key to the species:

Key to the known species of Physodera.

1 (6). Upper side with ivorylike callosities; antennæ from the fifth joint strongly flattened and moderately dilated.

[17] Ann. Mus. Civ. Genova 32 (1892) 385.

2 (3). Prothorax on each side with an ivorylike callosity. Philippine Islands, Tenasserim, eastern Sumatra, Deli, Medan, Balabac Island..... **P. dejeani** Eschsch.

3 (2). Prothorax without, but elytra with an ivorylike patch on disk.

4 (5). The flattened, slightly concave lateral part of prothorax one-fourth as broad as entire thorax, its disk convexly elongately arched, on each side with a few fine punctures; elytra dull in apical part, each with a subtransverse, reniform, ivorylike callosity on disk. Los Baños, Laguna Province, Luzon.
P. eburata sp. nov.

5 (4). The flattened lateral part of prothorax only one-sixth of its breadth, the arched part of disk transverse, subelliptical, smooth; elytra with a longitudinal subcallose yellowish spot, its apical part shining. Sandakan, Borneo..... **P. bifenestrata** sp. nov.

6 (1). Upper side without ivorylike callosities.

7 (12). Prothorax unicolorous, greenish or bluish.

8 (11). Elytra bronzy, more or less glistening purplish.

9 (10). Prothorax more than one and one-half times as broad as long at middle (3.4 : 2). Philippine Islands, Ceylon, Sumatra, Deli, Borneo, Java, China (*davidis* Fairm. i. l.).. **P. eschscholtzi** Parry.

10 (9). Prothorax much smaller than in the preceding species, less than one and one-half times as broad as long at middle. Hongkong (perhaps merely a subspecies of the preceding).
P. parvicollis v. de Poll.[18]

11 (8). Elytra steel blue. Celebes..... **P. cyanipennis** v. de Poll.[18]

12 (7). Prothorax fulvous with an irregular black dorsal vitta and a large round black lateral spot (this may be variable); elytra purplish black, apex edged with testaceous.
P. amplicollis v. de Poll.[18]

Allocota cyanipennis sp. nov.

A. viridipennis Motsch. simillima sed paulo brevior ac latior, capite prothoraceque plus cinnabarinis; elytris pulcherrime chalybeis, striis multo subtilioribus, stria subsuturali apice excepta, haud impressis, sternitis abdominalibus, 3., 4., et 5., distinctius punctatis. Long. 6.5, lat. 2.4 mm.

MINDANAO, Bukidnon Province, Tangcolan (*Baker 14261*).

Besides the greater redness of the head and prothorax and the steel blue elytra, this species differs from *viridipennis* Motsch.[19] also by the shorter and much finer seriate-punctate elytra, which, except the sutural stria toward the apex, are by no means sulcate; whereas in *viridipennis* all the striæ, especially the first, second, fifth, and sixth, are impressed toward the apex so that the interval between the seventh and eighth striæ forms a striking oblong callosity in the apical third.

[18] Notes Leyden Museum 11 (1889) 251–256.

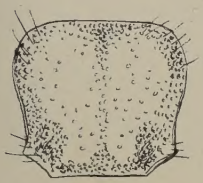
[19] This species I have before me in specimens collected by Prof. C. Fuller Baker at Puerto Princesa, Palawan, and at Sandakan, Borneo.

ILLUSTRATION

[From drawings by Heller.]

PLATE 1

FIG. 1. *Macrochilus ruficollis* sp. nov., thorax.
2. *Anaulacus sericeipennis philippinensis* subsp. nov., left elytron.
3. *Cyclosomus philippinus* sp. nov., left elytron.
4. *Physodera eburata* sp. nov.
5. *Physodera bifenestrata* sp. nov., elytra.
6. *Physodera bifenestrata* sp. nov., antenna.



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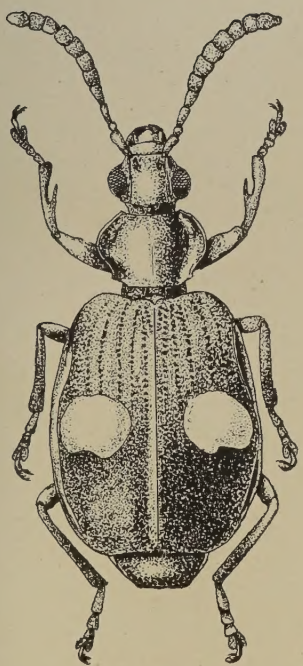

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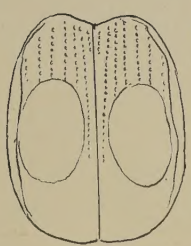

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PLATE 1.